This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

The American naturalist

Charles Valentine Riley, Essex Institute, American Society of Naturalists, University of Chicago Press. Journals Division, ...

AME 0626

HARVARD UNIVERSITY

VE RI
TAS

LIBRARY
OF THE
MUSEUM OF COMPARATIVE ZOÖLOGY

THE

AMERICAN NATURALIST,

An Illustrated Magazine

OF

NATURAL HISTORY.

EDITED BY

EDWARD D. COPE AND J. S. KINGSLEY,

ASSISTED BY

DR. C. O. WHITMAN, DR. C. E. BESSEY, THOMAS WILSON, PROF. C. M.
WEED, PROF. W. S. BAYLEY, PROF. E. A. ANDREWS.

VOLUME XXVII.

PHILADELPHIA, U. S. A.
THE EDWARDS & DOCKER Co.,
518 AND 520 MINOR STREET.
Sw 1893.

CONTENTS.

LEADING ARTICLES:

Gases in Living Plants, J. C. ARTHUR 1, 98
Certain Shell Heaps of the St. John's River, Florida (Illustrated). CLARENCE B. MOORE 8, 113, 605, 708
Legends of the Sumiro-Accadians of Chaldea, ALICE BODINGTON 14, 105
The Flight of Birds (Illustrated). J. LANCASTER 20
Joint Formations Among the Invertebrata (Illustrated). BENJAMIN SHARP 89
The Ancyclopoda, Chalicotherium and Artionyx (Illustrated) H. F. OSBORN .. 118
The Quantity of Human Life, J. LAWTON WILLIAMS 198
The Titanotherium Beds (Illustrated). J. B. HATCHER 204
An Organism Produced Sexually without Characteristics of the Mother (Illustrated). TH. BOVERI 222
On the Classification of the Longipennes, R. W. SHUFELDT 233
The Genealogy of Man (Illustrated). E. D. COPE 321
The Probable Physiognomy of the Cretaceous Plant Population, C. MACMILLAN 336
An Extreme Case of Parasitism, ROBERT HESSLER 346
On the Relationships and Distribution of the North American Unionidae, with Notes on the West Coast Species, C. T. SIMPSON 353
Recent Studies of Carnivorous Plants, J. G. SMITH 418
A New Theory of the Mechanical Evolution of the Metapodial Keels of Diplarthra (Illustrated). J. L. WORTMAN 421
Among the Cliff-Dwellers (Illustrated). C. L. WEBSTER 485
New Discoveries of Fossil Mammalia of Southern Patagonia, F. AMEGHINO .. 489
Recent Researches upon the Succession of the Teeth in Mammals, H. F. OSBORN 493
Symbiosis and Mutualism in Lichens, ROSCOE POUND 509
Evolution and Dichromatism in the Genus Megascops, E. M. HASBROUCK ... 521, 638
The Cinnamon Harvest-Spider and its Variations (Illustrated). C. M. WEED. 534
Some Correlations in Ontogeny and Phylogeny in Brachiopoda (Illustrated). C. E. BEECHER 599
Notes on Marine Laboratories of Europe (Illustrated). BASHFORD DEAN. 625, 697
The Spore-Forming Species of the Genus Saccharomyces, J. C. BAY 685
The Philosophy of Flower Seasons, H. L. CLARKE 769
The Morphology of Root Tubercles of Leguminosae (Illustrated). ALBERT SCHNEIDER 782
On the Structure of the Carapace in the Devonian Crustacean Rhinocaris; and the Relation of the Genus to Mesothyra and the Phyllocardia (Illustrated). J. M. CLARKE 793

General Physiology and its Relation to Morphology. C. O. Whitman........ 802
Bacteriology in its General Relations, H. L. Russell........................ 847, 1050
A Case of Lateroversion of the Ophidian Heart (Illustrated). P. A. Fish. 860
Phylogeny as an Acquired Characteristic (Illustrated). Alpheus Hyatt...... 865
The Eggs of *Pityophis melanoleucus* (Illustrated). J. P. Moore................ 878
On the Genera of the Dipnoi Dipneumones, Howard Ayres..................... 919
Animal Intelligence, Jas. Weir, Jr... 933
Notes on a Collection of Mollusks from North Western Louisiana, and Harrison County, Texas, L. W. Vaughn.. 944
Trenton and Somme Gravel Specimens Compared with the Ancient Quarry Refuse in America and Europe (Illustrated). H. C. Mercer........... 962
Notes on the Cochineal Insect, T. D. A. Cockerell.............................. 1041
The Color Variations of the Milk Snake (Illustrated). E. D. Cope............ 1066

Editorials.—The Antivivisectionists in Pennsylvania, 26; The Coming Peary Expedition, 26; Dates of Issue of the Naturalist for 1892, 27; The Law of Priority in Nomenclature, 134; The Meeting of the Societies at Princeton, 135; The American Table at Naples, 136; The Geological Survey of Illinois, 238; Reform in Orthography, 238; Mortality of the English Sparrow, 239; The American Entomological Society, 239; Book Publication in America, 359; The Journal of Geology, 360; A Preserve for New Zealand, 360; The Geological Survey of Georgia, 450; The Exhibition of Monstrosities, 450; Game Protection in New York, 451; The Sesquicentennial of the American Philosophical Society, 542; A Museum for Chicago, 886; Duplication of Names for Postoffices, 886; Bibliography of American Botany, 887; The Zoologists and the American Association, 887; Specimens in the Mails, 979; The Glacialists' Magazine, 980; The Bureau of Ethnology, 980; The Pronunciation of Arkansas, 980; College and University Periodicals, 1072; Appropriation for the Gypsy Moth Commission, 1072; Dates of Issues of the Naturalist for 1893, 1073.

Recent Books and Pamphlets.—28, 137, 240, 361, 452, 544, 650, 724, 808, 889, 982, ...1074

Recent Literature.—The Apodidae, 31; Darwin and After Darwin, 31; The Diseases of Personality, 33; Two Text-Books of Human Embryology, 140; Geological Survey of Texas, 1891, 142; Mineral Resources of the United States, 1889 and 1890, 143; Memoirs of the National Academy of Sciences, Vol. V, 243; Brooks and Bruce on the Embryology of the Macrura, 243; Campbell's Biology, 245; Correlation Papers of the U. S. Geol. Surv., Neocene, 246; Cary on the Evolution of Foot Structure, 248; Earle, on the Species of Coryphodontidae, 250; Lummis' Woodland of the Southwest, 364; Macmillan's Metasperma of the Minnesota Valley, 365; Ridgway, on the Anatomy of the Humming-Birds and Swifts—A Rejoinder, 367; Beddard's Animal Coloration, 371; A Summary Description of the Geology of Pennsylvania, Vols. I and II, 455; The Earth's History, 456; Wright's Light, 496; Evolution of the Colors of North American Land Birds, 547; Wright's Man and the Glacial Period, 550; Some Recent Books on Bacteriology, 554; Report on the Fish and Fisheries of the United States for 1888, 556; A Popular Botany, 653; Two Text-Books of Physiology, 654; Caldenwood on Mental Evolution, 654; Hawks and Owls of the United States, 727; Fresh Water Algae and the Desmidieae of the United States, 727; Gasteropoda and Cephalopoda of the New Jersey Cretaceous Marls, 728; Conquest of the Vegetable World, 811; Report of the Minnesota Geological and Natural History Survey for the Year, 1891, 811; The Vertebrate Paleontology of the Llano Estacado, 811; Weidersheim's Comparative Anatomy, 892; Mill's Diatomaceae, 892; Kennel's Zoology, 893; Iowa Geological Survey, First Annual Report for 1892, 985; Correlation Papers—The Newark System, 987; Spalding's Guide to the Study of Common Plants, 988; Annual Report of the United States Geological Survey, 1889–90, 990; The Report of the Death Valley Expedition, 990; Piersol's Histology, 1077; First Annual Report for 1892, of the Iowa State Geological Survey, 1078; The Paleozoic Group of Georgia, 1078; The Mesozoic Echinodermata of the United States, 1079; The Flora of the Dakota Group, 1079; Fritsch's Fauna of the Gaskohle of Bohemia.. 1079

GENERAL NOTES.—*Geography and Travels.*—Africa, 253, 458, 730; America, 255; Asia, 257, 461; Europe, 261, 730; Polar Regions, 263, 468; Australia, 260, 466; The Iowa State University Expedition to the West Indies and Florida Keys, 894; General Notes, 265........................ 464

Geology and Paleontology.—On the Formation of Oolite, 34; Geology of Northwestern Alabama, 34; The Mesosauria of South Africa, 35; Kansas Pterodactyls, 36; Paleozoic Formations of Southern Minnesota, 144; The Genus Hybodus, 145; On some Dicynodont and Other Reptilian Remains from the Elgin Sandstone, 145; Cenozoic Insects, 146: Uplifts in the Sierras of California, 147; A New Pliocene Ruminant, 147; A Remarkable Artiodactyle from the White River Epoch, 147; The White Clays of the Ohio Region, 148; Geology of Eastern Siberia, 267; Geological Features of Arabia Petraea and Palestine, 267; Vertebrate Fauna of the Ordovician of Colorado, 268; The Loess in Southern Russia, 269; Sources of the Texas Drift, 269; Currents of the North Atlantic, 375; Fins of *Palæaspis americana*, 375; New Reptiles from the Elgin Sandstone, 376; Fossil Reptiles from the Parana, 376; On the Systematic Position of the Genus Protogonodon, 377; Brown Coal and Lignite of Texas; Extinct Fauna of Mauritius, 379; The Western Lowland of Ecuador, 469; Devonian Fossils from Manitoba, 469; Jura and Trias in Taylorville, California, 470; The Post-Laramie Beds of Middle Park, Colorado, 471; Marine Pliocene Beds of the Carolinas, 471; The Oneonta and Chemung Formations in Eastern Central New York, 558; Tertiary Insects from Colorado and Utah, 558; A Supposed New Order of Gigantic Fossils from Nebraska, 559; Mammalia from the "Pits of Gargas," 560; The Norian Rocks of Canada, 656; The Caudal Fin of Ichthyosaurian Reptiles, 656; New Fossil Fishes from the Upper Lias, 657; Affinities of Ichthyornis, 657; Cretaceous Formations of Mexico, 657; On a New Musteline from the John Day Miocene, 658; The Mammals of the Deep River Beds, 659; Conditions of Erosion Beneath Deep Glaciers, 662; The Moon's Face, 734; North America During Cambrian Time, 734; Lower Silurian Brachiopoda of Minnesota, 735; Recent Volcanic Eruptions in California, 818; Continental Problems, 816; Mineral Resources of the United States for 1891, 816; Notes on Upper Devonian Fishes from Canada, 817; The Diatomaceae of the Triassic (?) Sandstone of New Jersey, 817; Do Glaciers Excavate? 818; Plistocene Deposits of Russia, 819; A New Plistocene Sabre-Tooth, 896; The Laurentian of the Ottawa District, 996; Relations of the Laurentian and Huronian Rocks North of Lake Huron, 996; The Carboniferous Glaciers of Central France, 997; Quicksilver Ore Deposits, 998; The Discovery of Miocene Amphisbaenians, 988; On Symmorium and the Position of the Cladodont Sharks, 999; Mud Avalanches in the Mustagh Mountains, 1082; Cladodont Sharks of the Cleveland Shale, 1083; The Neocene Sierra Nevada, 1084; Geological News, 37, 149, 270, 471, 560, 662, 736, 1001 1084

Mineralogy and Petrography.—The Origin and Classification of Igneus Rocks, 40; The Novaculites of Arkansas, 42; A New Occurrence of Ptiolite, 43; Mineral Syntheses, 45, 277, 567; Landauer's Blowpipe Analysis, 46; The Rocks of the Thalhorn, 272; The New Jersey Eleolite-Syenite, 272; Mica Peridotite from Kentucky, 273; Rhyolites in Maryland and Penn., 273; The Nepheline and Lencite Rocks of Brazil, 274; Crystallographic Study of Diopsides, 275; Herderite from Hebron, Maine, 276; Methods and Instruments, 278; An Appendix to "Gems of North America," 278; Description of the New Rock Type, Malchite, 380; Petrography of Hokkaido, Japan, 380; Two Peculiar Rocks from Siberia, 381; An Ottrelite Bearing Conglomerate in Vermont, 382; Lithophysae in the Rocche-Rosse, 382; The Composition of the Dune Sands of the Netherlands, 382; Quartz-Gabbro in Maryland, 383; Minerals from the Diamond Fields of Brazil, 383; Optical Anomalies, 385; Isomorphism, 386; Etched Figures, 386; Microchemical Reaction. 387; Miscellaneous, 387; The Petrography of the Abukuma Plateau, Japan, 562; The Leucite-Tephrite of Hussak from New Jersey, 562; A Sodalite-Syenite from Montana, 563; The Anorthosites of Canada, 564; The Melibocus "Massiv" and its Dyke Rocks, 546; The Granites of Argentina, S. A., 565; New Edition of Rosenbusch's Volume of Minerals, 567; Instruments, 567, 1093; Rock Separations, 568; Anorthorites and Diabases from the Minnesota Shore of Lake Superior, 898; Volcanic Rocks of the Andes, 898; Basalts and Trachytes from Gough's Island, 899; Origin of the Gneisses of Heidelberg, 899; American Minerals, 901; Trachytes and Andesites of the Siebengebirge, 1003; Variolite Dyke in Ireland, 1003; Chemical Nature of Eruptive Rocks, 1003; Norites in the Eastern United States, 1004; Ottrelite Conglomerate in Vermont, 1004; Chalcedony and other Silicious Spherulites, 1005; Danalite from Redruth, Cornwall, 1005; Mirabilite Changed to Theradite, 1006; The Schists of Southern Berkshire, Massachusetts, 1087; The Phonolytes of the Hegan, 1087; The Rocks of a New Island off Pantelleria, 1088; Analyses of American Minerals, 1090; North American Minerals, 1091; Physical Properties of Minerals, 1092; Petrographical News, 42, 274, 1005, 1008; Mineralogical News, 43, 276, 384, 903, 1006; New Minerals, 45, 566, 900; Miscellaneous, 387, 903 1008

Botany.—A New Edition of Wolle's Desmids, 47; Botanical Definitions, 47; Timely Words as to the Nomenclature Question, 48; Engler and Prantl's Naturlichen Pflanzenfamilien, 49; An International Botanical Congress, 279; North American Fungi, Century, XXIX, 474; New York Fungi, 474; Seymour and Earle's Economic Fungi, 475; Halsted's Weed-Seeds, 475; Morong's Naiadaceae, 475; Canadian Mosses and Lichens, 476; *Caeoma nitens*, 569; Our Naids, 569; Hough's American Woods, 570; Allen's Characeae of America, 570; The Plants of the Bahamas, Jamaica, and Grand Cayman, 664; The Saprolegniaceae of the United States, 665; The Coming Botanical Meetings at Madison, 738; Freshwater Algae, 739; Check-List of New North American Plants, 821; Shall we Decapitalize Specific Names? 821; The Use of Personal Names in Designating Species, 822; Botany at the Madison Meetings, 823; Kuntze's Revisio Generum Plantarum, etc., III, 1010; Botanical News 279

Zoology.—Locomotion of Limpets, 51; Tunicate Studies, 51; Skeleton and Teeth of the Australian Dugong, 51; On the Cephalohumeral Muscle and the So-Called Clavicle of Carnivora, 52; A New Synaptomys from New Jersey, 53; A New Evotomys from Southern New Jersey, 54; The Cercaria Stage of Amphistomum, 151; Fecundation of the Eggs of *Clinus argentatus*, 151; Preliminary Descriptions of New Fishes of the Northwest, 151; The Larynx of Batrachia, 154; The Kidney of Amphiuma, 154; On a New Spade-Foot from Texas, 155; The Pedal Skeleton of the Dorking Fowl, 156; Allen's Faunal Areas of North America, 282; The Madagascar Fauna, 283; The Nephridia of Amphioxus, 283; The Position of the Marsipobranchs, 284; Degeneration of the Clitoris, 284; The German Zoological Society, 388; Eyes of Polychaetes, 389; Arachnida, 389; The Fishes of the Pacific Coast of America North of Cerros Islands, 390; On the Mechanical Genesis of the Scales of Fishes, 391; Systematic Position of the Kiwi, 392; Mammals from the Galapagos Islands, 394; The New England Species of Balanoglossus, 477; Marsipobranchs, 477; Lateral Line of Siluroids, 477; Prodromus of a New System of the Non-venomous Snakes, 477; A Medusa from Lake Tanganyika, 571; The Air-Bladder and Weberian Ossicles in the Siluroid Fishes, 571; Age Modifications of the Mucous Lining of the Stomach of Ruminants, 572; A Deformity Inherited, 667; Preliminary Note on the Relationship of the Species Usually United under the Generic Name Sebastodes, 668; Batrachians of British India, 671; Washington and British Columbia Ornithology, 671; Notes on the Classification of the Cryptodira, 672; Two New Species of North American Testudinata, 675; Zoology of the Lower Saskatchewan River, 741; Classification of the Actiniae, 829; Maioid Crabs in the National Museum, 830; A New Lancelet 830; Descriptions of Four New Rodents from California, 831; How Young Flickers are Fed, 1014; Forsyth Major and Röse on the Theory of Dental Evolution, 1014; Effects of Temperature on the Coloring of Lepidoptera, 1016; Fish Acclimatization on the Pacific Coast, 1017; The Molluscs of the Water Mains of Paris, 1094; The Orthopterous Insects of the Galapagos Islands, 1094; An Axillary Pocket in Certain Chameleons, 1094; Origin of the Human Face, 1095; The Ground Squirrels of the Mississipi Valley, 1095; Zoological News, 56, 285, 484, 573, 671, 741, 837 1096

Embryology.—Gastrulation of Aurelia, 57; Cleavage in *Aequoria forskalea*, 58; Experimental Embryology, 158; Studies in Insect Embryology, 160; The Star-Fish Larva, 288; Germ-layers of Amphioxus, 288; Epigenesis, 289; Form and Chemical Composition, 290; Echinoderm Eggs, 395; Electricity and Cleavage, 396; Membranes of the Sea-Urchin Egg, 397; Experiments on Cleavage, 388; Germ-Layers of Vertebrates, 485; The Mantle of Ascidians, 486; The Sea-Urchin Egg, 743; A Contribution to Insect Embryology, 745; Frog Eggs Under Pressure, 1097; Embryology of Chiton, 1098; Lithium Monsters, 1099; Mechanics of Embryology 1100

Entomology.—The Pupa of *Argyramoeba oedipus*, 60; Horn-Fly in Canada and Texas, 63; The Wheat Frit-Fly, 64; On a Small Collection of Coleoptera from the High Mountains of British Columbia, 164; A Peculiar Seed Like Case-Worm from the Grand Cañon, 166, 402; The Pear-Tree Psylla, 293; Notes on Ohio and other Phalangiidae, 294; Gall-Producing Insects, 296; Recent Publications, 296, 1106; Termitophilous Insects, 400; Notes on the Mouth Parts and Thorax of Insects and Chilopods, 400; The Woolly Alder Aphis, 402; The Puparium of Blepharipeza, 402; North American Cormetidae, 574; An American Species of Sabacon, 574; Puparium of Jurinia, 576; Spiders Collected in New Mexico and Arizona, 679; Lepidopterous Gall on Bigelovia, 680; North American Locusts, 681; The Work of the Gypsy Moth Commission (Illustrated), 750; Two Twig Galls on *Populus fremontei*, 904; A Wooly Leaf-Gall on Oak near Grand Cañon, 905; A Hymenopterous Gall on the Creosote Bush, 905; The Androchonia of Lepidoptera, 1018; Fleshy Cecidomyiid Twig-Gall on *Atriplex canescens*, 1021; *Trichodactylus* in California, 1021; Lycaenid Larva on Atriplex, 1104; Honey Adulterations, 1105; North American Noctuidae, 1106; Entomological News, 64, 169, 578 681

Microscopy.—The Solution of the Dust Problem in Microscopy (Illustrated), 405; Cooling Paraffine, 407; A Method of Injecting the Blood-Vessels of Birds, 583; Method of Preparing Molluscan Ova 1026

Psychology.—Notes on Habits of European Birds, 65; A Nest-Building Frog, 67; Horse "Human Nature," 68; Vision in a Young Girl Six Years of Age, Operated upon for Double Congenital Cataract, 171; The Sense of Taste in a Sea-Anemone, 298; Feeding of Snakes 298

Archeology and Ethnology.—Legendary Evolution of the Navajo Indians, 69; Area and Population of European Countries, 173; A Measure of Civilization, 174; International Congress of Americanists, 300, 579, 755, 838; Language Versus Anatomy in Determining Human Races, 581; The Nephrite of New Zew Zealand, 582; The Exposicion Historico-Americano, 838, 907; The Explorations in the Delaware Valley, 1023; The International Congress of Pre-Historic Archeology and Anthropology at Moscow, 1892 1024

RECORD OF AMERICAN ZOOLOGY 85

PROCEEDINGS OF SCIENTIFIC SOCIETIES, 80, 176, 306, 409, 488, 585, 682, 762, 913, 1028 1108

SCIENTIFIC NEWS, 82, 191, 410, 489, 592, 683, 764, 844, 917, 1038 1115

INDEX.

ACANTHODES semistriatus.... 149
Accipiter nisus.................. 65
Acmœops proteus Kirby...... 166
Acquired Character.........88 191
Acquired Characteristic............... 865
Acrodus keuperinus.................... 662
Actiniae, Classification of............ 829
Acutomentum E. & E................ 669
Adelonycteris fiuscus.................... 53
Æsculus hippocastanum L........... 589
Affinities of Ichthyornis.............. 657
African Travel, notes of.............. 254
Agassiz Scientific Society of Oregon 683
Agathaumas, plaster cast of......... 593
Agelacrinitidae......................... 87
Age Modifications of the mucous Lining of the Stomach of Ruminants......................... 572
Agrimonia mollis....................... 1112
Agrimonia striata...................... 1112
Agosia falcata........................... 153
Agosia shuswap......................... 154
Air-Bladder and Weberian Ossicles in the Siluroid Fishes........... 571
Alabama Geological Survey......... 192
Algae (Fresh Water).................. 739
Algae and Desmids (Fresh Water) of the U. S., Stokes'............ 727
Alpheus saulcyi......................... 243
Amara remotestriata Dej............. 164
Ameghino, F,, New Discoveries of Fossil Mammalia in Southern Patagonia..................... 439
American Entomological Society... 239
American Geological Society, Fifth Annual Meeting.................. 175
American Minerals.................... 901
American Morphological Society... 307
American Psychological Association.............................. 186
American Society of Naturalists..... 306
American Woods, Houghs.......... 570
Amnicola lutetiana...................... 1094
Among the Cliff-Dwellers, C. L. Webster............................ 435
Amphibolips confluentus Harr...... 289
Amphibolips ilicifoliae Bass......... 289
Amphibolips iams O. S............... 289
Amphisbaenians, Miocene........... 998
Amphistomum subclavatum 151
Amphizoa lecontei..................... 296
Analcite.................................. 1007
Analysis of American Minerals.... 1090
Analysis of Black Soil.............. 1008
Anchitherium equinum............... 661
Auctospina E. & B................... 670
Ancylopoda 118
Ancylopoda, Chalicotherium and Artionyx, H. F. Osborn........ 118
Andricus cornigerus O. S........... 289
Androchonia of Lepidoptera..1014 1018
Animal Coloration, Beddard's...... 371
Animal Intelligence, Jas. Weir, Jr. 933
Anomaloides 736
Anomite 1093
Anorthosites of Canada. 568
Anorthosites and Diabases from the Minnesota Shore of Lake Superior............................ 898
Antarctic Continent.................. 1040
Antivivisectionists in Pennsylvania. 26
Authonomus musculus................ 64
Aphis persicoe-niger................. 578
Aphodius congregatus Mann........ 166
Aphodius granarius Linn............ 165
Aphodius ursinus Mots............... 165
Apodidae, Bernard's.................. 31
Appendicularia mossii................ 51
Apus aequalis........................... 800
Aquatic Invertebrate Fauna of Wyoming and Montana........ 1096
Arabia Petraea 267
Arachinda...... 389
Aralia eocenica......................... 271
Archeology 69, 173, 300, 579, 755 838, 907, 1023
Archean News.....................149 270
Arctocephalus australis............... 394
Area and Population of European Countries............................ 178
Argyramoeba oedipus Fab........... 60
Arkansaw or Arkansas............... 980
Arthur, J. C., Gases in Living Plants 1
Artiodactyle from the White River Epoch, description of, E. D. Cope............................... 147
Artionyx................................. 118

Artionyx gaudryi 131
Ascidians 486
Asia Minor, exploration of 463
Aspidium cristatum 188
Association of American Anatomists 308
Astraspis desideratum 268
Asymmetron lucayanum 830
Atalapha brachyotis 394
Atriplex canescens 1021
Australian Society for the Advancement of Science 683
Australia, exploration in 466
Avian fauna of Post-pliocene beds of Queensland 150
Axillary Pocket in certain Chameleons 1094
Ayres, H., On the Genera of the Dipnoi Dipneumones 919
Azurite 276

BACTERIA and their Products. 556
  Bacteriology 554
  Bacteriology in its General Relations, A. L. Russell 847 1050
Baden, Geological History of 1089
Baddeleyite 566
Bailey, L. H., What is an Acquired Character 191
Balanoglossus kowalevskii 477
Balanoglossus, the New England species of 477
Banks, N., Notes on the Mouth-parts and Thorax of Insects and Chilopods 400
Baram River and Mt. Dulit, Borneo, exploration of 782
Basalts and Trachytes from Gough's Island 899
Batrachians of British India 671
Batrachian News 287
Batrachia from Texas 672
Baur, G., Descriptions of Testudinata 675
Baur, G., The Discovery of Miocene Amphisbænians 998
Baur, G., Notes on American Box Tortoises 677
Baur, G., Notes on the Classification of the Cryptodira 672
Bay, J. C., Spore-forming species of the genus Saccharomyces... 685
Bay of Fundy Coast during the Glacial Period 1086
Beecher, C. E., Some Correlations in the Ontogeny and Phylogeny of the Brachiopoda 599
Belonostomus sweetii 150
Bembidium incertum Mots. 164
Beryl 384
Bessey, C. E., Botanical Nomenclature 47
Bessey, C. E., Botany at the Madison Meeting 823
Bessey, C. E., Allen's Characeæ of America 570
Bessey, C. E., Review of Dana's How to know Wild Flowers.. 658
Bessey, C. E., Hough's American Woods 570
Bessey, C. E., Review of Humphrey's Saprolegniaceæ of the United States 664
Bessey, C. E., Morong's Naiads... 569
Bessey, C. E., Review of MacMillan's Metasperma of the Minnesota Valley 865
Bessey, C. E., Review of Spalding's Guide to the Study of Common Plants 988
Bessey, C. E., Richard's Development of Caeoma nitens 569
Bessey, C. E., Shall we decapitalize specific names? 821
Bessey, C. E., Use of Personal names in desiginating species. 822
Bibliography of American Botany.. 887
Bigelow, R. P., Review of Haeker's Cleavage in Aequoria forskalea 58
Bigot, J. F. M 845
Biological Expedition of the Iowa State University to the West Indies and the Florida Keys... 894
Biological Station at Plön 317
Biology, Campbell's 245
Bird Bones (Neocene) 737
Birds, Mexican 742
Birds of Michigan 1096
Birds of Paradise and the Bower-Birds 764
Bismuthinite 903
Black Sea, hydrographical exploration of 262
Blarina parva Say 573
Blastomeryx antilopinus 662
Bles, E. J 844
Blowpipe Analysis, Landauer's.... 46
Blueite 566
Bodington, A., Legends of the Sumiro-Accadians of Chaldea. 14, 105. Errata 410
Bolivina stirgillata 561
Book Publication in America 359
Borneo, travels in 782

Boston Society Natural History, 81 181, 313, 409, 488, 585, 682, 1113
Botanical Club, Proceedings of, at Madison, Aug., 1893.......... 913
Botanical Definitions.................... 47
Botanical Meeting at Madison...... 788
Botanical Notes........................ 279
Botany, 47, 279, 474, 569, 664, 788, 821
Botany at the Madison Meetings, report of........................... 828
Boulders of silicious limestone...... 44
Boveri, The Organism produced sexually, without characteristics of the mother................ 222
Box Tortoises, descriptions of. G. Baur.................................. 677
Brachiopoda of Minnesota Lower Silurian.............................. 735
Brazilite..............................45, 1007
Bristol, C. L. Restoration of Osmic Acid Solutions.................... 175
Brook, G................................ 917
Brooks and Bruce on the Embryology of the Macroura....... 248
Brown Coal and Lignite of Texas, Dumble's.......................... 379
Bufo compactilis........................ 156
Bufo debilis.............................. 156
Bufo punctatus.......................... 156
Bulima trigona............. 561
Buprestis lauta Lec.................. 165
Bureau of Ethnology.................. 980
Burma to Assam, road from......... 465
Burrows of Rodents (fossil)......... 559
Byrrhus cyclophorus Kirby.......... 165
Byrrhus kirbyi Lec..................... 185

CACHE, Long Bluff.................. 616
Cacoma nitens....................... 569
Calcium carbonate crystal..... 276
Call, Prof. R. E........................ 411
Calyptrate Muscidæ.................. 578
Canis anceps........................... 660
Canis lupus............................. 560
Cape Town University.............. 817
Carabus oregonensis Lec............ 164
Carapace in the Devonian Crustacean Rhinocaris. J. M. Clarke 793
Carboniferous Glaciers of Central France.................................. 997
Carnivorous Plants.................... 413
Carrington, Dr. B...................... 490
Case-worm from the Grand Cañon, description of..................... 166
Caucasus, Travels in.......... 261
Caudal Fin of Ichthyosaurian Reptiles...................................... 651
Cecidomyia atriplicis................. 1021
Cecidomyia caryocola O. S.......... 273
Cecidomyia holotricha O. S......... 273
Cecidomyia persicoides O. S........ 273
Cecidomyia tubicola O. S............ 273
Cecropia cocoons........................ 184
Cenozoic Insects......................... 146
Cenozoic news, 38, 150, 271, 473, 561, 663, 737, 1002, 1085
Cephalo-humeral muscles and the so-called Clavicle of Carnivora....................................... 52
Cephalophus spadix.................... 56
Cercaria Stage of Amphistomum.... 151
Cerussite................................. 44
Chabasite................................ 884
Chalcedony and other Silicious Spherulites......... 1095
Chalicotherium...................118, 128
Chameleon isabellinus 286
Chameleon vulgaris.................... 1095
Champia parvula........................ 279
Characeae of America, Allen's..... 570
Charcot, M............................... 1038
Check-List of New North American Plants.............................. 821
Chelonioidea............................. 678
Chelydridae....... 673
Chelydroidea................. 673
Chionoecetes tannerii................. 830
Chiton marmoratus.................... 1098
Chiton squamosus...................... 1098
Christianite.............................. 384
Cinnamon Harvest Spider and its Varieties. C. M. Weed........ 534
Cladodont Sharks........ 1083
Cladodus keppleri........................ 1083
Clarke, H. L. Philosophy of Flower Seasons.................. 769
Clarke, J. M. On the structure of the Carapace in the Devonian Crustacean Rhinocaris; and the Relation of the genus to Mesothyma and the Phyllocarida....................................... 793
Clark's Mesozoic Echinodermata of the United States................. 1079
Cleavage in Aequoria forskalea, Haeker's.............................. 58
Cleavage, Lock's experiments on... 398
Clidastes velox......... 1985
Clidastes westii......................... 38
Cliff Dwellers................. 435
Clupea sprattelloides.................. 56
Clymnella elongata..................... 1096
Coccosteus cuyahogae................. 560
Coccinella transversoguttata Fabr.. 165
Coccus cacti.............................. 1041
Cockerell, T. D. A. Notes on the Cochineal Insect................. 1041
Coelocerus grandis 830

Cole, A. H., Solution of the Dust Problem in Microscopy......... 405
Coleoptera from High Mountains of British Columbia................ 164
Coloceras globatum.................... 872
Color Variations of the Milk Snake E. D. Cope........................ 1066
Comparative Anatomy, Wiedersheim's............................ 892
Cone-in-Cone Structure............... 900
Congress Auxiliary of the World's Columbian Exposition of 1893. 1028
Congress of Evolutionists............ 1035
Conklin, E. G., Methods of preparing Molluscan Ova.......... 1026
Conquest of the Vegetable World, Bourdeau's.......................... 811
Continental Problems.................. 816
Conway, W. M., expedition of..... 465
Cooke, M. C............................ 170
Cookeite 901
Cope, E. D.............................. 1038
Cope, E. D., Color Variations of the Milk Snake.................. 1066
Cope, E. D., Description of Spea laticeps Cope..................... 155
Cope, E. D., Fossil Reptiles from the Parana......................... 376
Cope, E. D., The Genealogy of Man.................................. 321
Cope, E. D., A New Plistocene Sabre-Tooth....................... 896
Cope. E. D., On Symmorium, and the Position of the Cladodont Sharks.............................. 999
Cope, E. D., Prodomus of a new system of the non-venomous Snakes............................... 477
Cope, E. D,, Review of Beddard's Animal Coloration............... 371
Cope, E. D.. Review of Calderwood's Mental Evolution...... 654
Cope, E. D., Review of Cary's Study in Foot Structure......... 248
Cope, E. D., Review of The Death Valley Expedition....... 990
Cope, E. D., Review of Earle's Species of Coryphodontidae... 250
Cope, E. D., Review of Fritsch's Gaskhole of Bohemia............ 1079
Cope, E. D., Review of Forsyth Major and Rõse on the Theory of Dental Evolution............ 1014
Cope, E. D., Review of Keeler's Evolution of the North American Land Birds................. 547
Cope, E. D., Review of Wright's Man and the Glacial Period... 550
Cope E. D., Remarkable Artiodactyle from the White River Epoch.............................. 147
Cope, E. D., Vertebrate Paleontology of the Llano Estacado..... 811
Corning, Dr. H. K..................... 844
Correlation Papers of the U. S. Geol. Surv. Neocene.......... 246
Correlations of Ontogeny and Phylogeny in the Brachiopoda, C. E. Beecher........................ 599
Corvus monedula....................... 66
Coryphodontidae, Earle's species of...................................... 250
Cosmetidae, North American 574
Coulterophytum 280
Crassidulus florescens................. 39
Cretaceous Formations of Mexico.. 657
Cretaceous Plants...................... 336
Cretaceous strata on Staten Island.. 737
Crommelin, Dr., Jan Pieter van Wickevoort.......................... 411
Crustaceans from the Indian Archipelago............................. 742
Cryptodira, classification of, G. Baur................................ 672
Crystalline Schists..................... 1005
Crystallization, experiments on..... 1007
Cuprocassiterite 566
Currents of the North Atlantic...... 375
Cyclus scottii............................ 271
Cyclopidius incisivus.................. 661
Cynodesmus thooides................. 660

DAHOMEY, coquest of........... 731
Daimonelix.......................... 559
Danais archippus................ 1018
Danalite from Redruth, Cornwall.. 1005
Darwin and after Darwin, Romanes'................................. 31
Dates of issue of Naturalist for 1892 27
Datholite............................... 1091
Davii, J. W.............................. 917
Dean, B., Notes on the Marine Biological Laboratories of Europe.........................625 697
Death Valley Expedition............ 990
Decapods from the Indian Archipelago 742
DeCandolle, Alphonse Louis Pierre Pyramus.............. 592
Deformity Inherited................... 667
Degeneration of the Chitons......... 283
Dendrohyrax validus.................. 56
Dendromys nigrifrons................. 56
Dendy, Dr. A............................ 917
Dental Evolution........................ 1014
Dermatemydidae........................ 673
Dermochelyidae......................... 673

Desmatippus crenidens.............. 660
Detection of Minerals.............. 387
Development of the vertebrae and the myotomic coelum in Anguis and Tropidnotus.......... 285
Devonian Fossils from Manitoba... 469
Devonian Plants...................... 1084
Diamond in Meteoric Iron.......... 1009
Diapheromera femorata.............. 1113
Diatomaceae, Mill's.................. 892
Diatomaceae of the Triassic (?) Sandstone of New Jersey...... 817
Dichromatism......................... 638
Dicranura vinula...................... 170
Dictyorhabdus priscus............... 268
Dicynodont Remains from the Elgin Sandstone.................. 145
Dinichthys intermedius.............. 270
Dinobastis serus...................... 897
Dinornis queenslandiae.............. 1002
Diopsides.............................. 275
Diplodus problematicus............. 149
Diptera brasiliana..................... 578
Disastrophus cuscutaeformis O. S.. 239
Disastrophus nebulosus O. S......... 289
Discites hibernicus.................... 736
Diseases of Personality, Ribot's.... 33
Dreissenia curta....................... 1094
Dreissenia paradoxa.................. 1094
Dreissenia tumida..................... 1094
Drift in Texas, sources of........... 269
Dugong, skeleton and teeth of an Australian......................... 51
Dumortierite........................... 1006
Dune Sands in the Netherlands, composition of.................. 382
Duplication of Names of Post-offices 886
Dust Problem in Microscopy, A. H. Cole............................ 405

EARLE, C., On the systematic position of Protogonodon...... 377
Earth's History, Robert's..... 456
Echinoderm Eggs..................... 395
Echinoderms of the Eocene......... 478
Echinus microtuberculatus 226, 228 ....229 743
Ecuador, Western Lowlands of.... 467
Ecuadorian Andes, Travels in...... 255
Editorials 26, 134, 238, 359, 450, 541, 886, ...979 1072
Edwards, A. M., Diatomaceae of the Triassic (?) Sandstone of New Jersey........................ 817
Effects of Temperature on the Coloring of Lepidoptera............ 1016
Eichornia crassipes................... 1113
Eigenmann, C. & R., Preliminary descriptions of New Fishes from the Northwest............ 151
Eigenmann, C. H. and C, H. Beeson, Preliminary note on the Relationship of the Species usually United under the Generic Name Sebastodes.......... 668
Eighth International Congress of Americanists, Paris............. 755
Eggs of Pityophis melanoleucus, J. P. Moore......................... 878
Errata.................................... 1115
Elaps fulvus............................. 286
Electricity and Cleavage............ 396
Elephas meridionalis................. 37
Elginia mirabilis...................... 376
Embryology 57, 158, 288, 395, 485..............................743 1097
Embryology of Chiton............... 1098
Embryology, Hertwig's.............. 141
Embryology of the Macrura......... 243
Emydidae............................... 675
Enchodus bleekeri..................... 737
Engadine Lakes, origin of.......... 1086
Entomology 60, 164, 293, 400, 574, 679, 750...............904, 1104
Entomological Bulletins............. 1106
Entomological Notes 64.........199 681
Entomological Study................. 170
Eolite syenite from New Jersey.... 272
Epigenesis.............................. 289
Equus minutus......................... 812
Equus sivalensis....................... 39
Eracia brevicornis.................... 1096
Eriptychus americanus............... 268
Erosion beneath Deep Glaciers..... 662
Eruptive Rocks, chemical nature of 1003
Erysiphe graminis..................... 474
Esquimaux.............................. 821
Etched Figures......................... 386
Ethnology 69, 178, 300, 579, 755, 838 907
Euclase.................................. 384
Eudamus tityrus....................... 1018
Eulalie lobulata....................... 1096
Ennomos autumnaria................. 1016
Eunotosaurus africanus.............. 38
Euphorbia pholyphylla............... 280
Euphorbia strictior.................... 280
Evolution and Dichromatism of the Genus Megascops, E. M. Hasbrouck...........................521 638
Evolution of Foot Structure, Cary's 248
Evolution of the North American Land Birds, Keeler............. 547
Evolution of Teeth in Mammalia in its bearing up the Problem of Phylogeny.................... 586
Evotomys gapperi rhoadsii......... 54

Explorations in the Delaware Valley.. 1023
Explorations in the Amazon Basin 1115
Exposicion Historico Americano, Madrid Spain, 1892........840 907
Experimental Embryology........... 158
Extreme Case of Parisitism, R. Hessler.. 346

FAN dentition............................. 821
Faunal Areas of North America, Allen's........................ 282
Fauna (extinct) of Mauritius........ 379
Fecundation of the Eggs of Chinus argentatus 151
Felis atrox Leidy........................ 897
Fertilization of the Reptilian egg.. 285
Finger Lakes of New York......... 1085
Fins of Palaeaspis americana....... 875
Fish Acclimatization on the Pacific Coast 1017
Fishes (dwarfed)......................... 741
Fishes (fossil) from the Upper Lias.................................... 657
Fishes of the Pacific Coast of America north of the Cerros Islands................................. 890
Fish fauna of the Permian of France......... 560
Fish and Fisheries of the U. S. for 1888............................ 556
Fish, P. A., A Case of Lateroversion of the Ophidian Heart... 860
Flickers, how fed........................ 1014
Flight of Birds, J. Lancaster........ 20
Folgerite.................................... 566
Forest Flora of New South Wales. 1039
Form of organic structure dependant on Chemical Composition. 290
Forsyth Major and Rõse on the Theory of Dental Evolution... 1014
Fossil Bones, relative age of......... 149
Fossil Plants from Kootanie......... 1085
Fossil Plants from Texas.... 1085
Fourchite Boulder....................... 275
Foxes in Staten Island................. 1108
Friedelite.................................... 276
Frit-fly....................................... 64
Fritsch's Fauna of the Gaskohle of Bohemia............................ 1079
Frog's Eggs under Pressure......... 1097
Fuchsite...................................... 1090
Fungi (Economic) Seymour and Earle's................................ 475
Fungi of New York...................... 474
Fungi (North American)............. 474

GADUS tomcodus...................... 588
Gall on a Creosote Bush, description of............................ 906
Gall (Lepidopterous) on Bigelovia. 680
Gall on an Oak near Grand Cañon, description of...................... 906
Galls on Populus fremontii, descriptions of............................. 904
Gall-producing Insects................ 296
Game Protection in New York..... 451
Ganophyllite.............................. 277
Gases in Living Plants, J. C. Arthur.................................. 1
Garenganze, Travels in............... 253
Gasteropoda and Cephalopoda of the New Jersey Cretaceous Marls, Whitfield's.............. 728
Gastrulation of Aurelia............... 70
Geikia elginensis......................... 356
Geikielite.................................... 576
Geissolepis.................................. 286
Gems of North America, appendix to.. 278
Genealogy of Man, E. D. Cope.... 321
Genera of Dipnoi Dipneumones, H. Ayres.............................. 919
Genth, F. A................................ 814
Geography, a Chair of................ 814
Geography and Travels 253, 458, 780 894
Geological Congress................... 1031
Geological Features of Arabia Petraea and Palestine............... 267
Geological Society of France....... 1040
Geological Survey of Illinois........ 238
Geological Survey of Georgia....... 450
Geological News 37, 149, 270, 471, 662, 736,......................1001 1084
Geology of Eastern Siberia.......... 267
Geology of Northeastern Alabama.. 84
Geology of Northern Africa......... 471
Geology and Paleontology 84, 144, 267, 375, 469, 558, 656, 734, 813,............................996 1082
Geology of Pennsylvania, summary description of..................... 455
German Zoological Society.......... 388
Germ-layers of Amphioxus, Lwoff's 288
Germ-layers of Vertebrates.......... 485
Glacialists' Magazine.................. 980
Glaciers excavate?...................... 817
Glaciers of New South Zealand.... 260
Glacial sand................................ 37
Glauconite.................................. 1009
Gneisses of Heidelberg, origin of.. 889
Goniocteria arctica Mann............ 166
Goniometer................................ 1093
Gonodactylus chiragra................ 248

Gordonia duffiana........................ 376
Gordonia huxleyana........................ 376
Gordonia juddiana........................ 376
Gordonia traquairii........................ 376
Grahamite in Texas........................ 561
Granite, formation of........................ 270
Granites of Argentina, S. A......... 565
Granitic rocks........................ 472
Graphitite........................ 901
Grapholita interstinctana........................ 578
Graptemys pulchra........................ 675
Greef, Richard........................ 411
Grossularite........................ 44
Ground Squirrels of the Mississippi Valley........................ 1095
Growth of the Rattle of the Rattlesnake........................ 286
Gurley, W. F. C........................ 1038
Gypsy Moth Commission, C. M. Weed........................ 750
Gypsy Moth, extermination of....... 1072

HABITS of certain European Birds........................ 65
Haematobia serrata............ 68
Hagen, H. A........................ 170
Halite........................ 1006
Halitherium schinzii........................ 51
Harpalus innocuus Lec........................ 164
Hasbrouck, E. M., Evolution and Dichromatism in the genus Megascops........................521 638
Hatcher, J. B., Titanotherium Beds 204
Hauchecornite........................ 566
Hantken, M. von........................ 918
Hauyne in pumice........................ 275
Hawks and Owls of the U. S., Fisher's........................ 727
Heat Conductivity of Uniaxial Crystals........................ 1098
Heleopelta........................ 150
Helvite........................ 1006
Hematite........................ 1092
Hematite in Tertiary formations... 561
Hemichorda........................ 671
Hemimorphic Compounds........... 1092
Henshaw, S........................ 412
Heterocera........................ 681
Herderite from Maine........................ 276
Hersler, R., An Extreme Case of Parasitism........................ 336
Hippodamia convergens Guer...... 165
Hippodamia 5-signata Kirby......... 164
Hippopotamus, a young........................ 318
Hippiscus........................ 296
Holland, W. J., Nest Building Frog........................ 67
Hollick, A., Notes on the Geology at Arrochar, Staten Island..... 1110
Homfray, D........................ 917
Honey adulterations........................ 1105
Hoplocepalus suboccipitalis.......... 56
Horn-fly in Canada and Texas....... 63
Horse, benevolence in a............. 68
Human Embryology, Minot's....... 140
Humming-Birds and Swifts, R. W. Shufeldt........................ 367
Humphrey, J. E........................ 412
Hyaena brevirostris........................ 561
Hyaena crocuta........................ 560
Hyaena macrostoma........................ 39
Hyastenus caribbeus........................ 830
Hyatt, A., Phylogeny of an Acquired Characteristic............ 865
Hybodus basanus........................ 145
Hylocopa aenipennis........................ 1022
Hymenocaris vermicauda............ 799
Hyracops........................ 128

IBEA, travels in........................ 458
Ice-age........................ 561
Igneous Rocks, origin and classification of........................ 40
Ihering, Dr. H. von........................ 844
Incolaria securiformis........................ 662
Indiana Academy of Science........ 187
Iniopsis caucasicus........................ 663
Inoceramus problematicus............ 658
Insect Embryology, Wheeler's...... 745
Insect Embryology, Henking's studies in........................ 160
Insects, cenozoic........................ 146
Insects (injurious)........................ 681
Insects injurious to Cranberries..... 578
Insects (injurious) of Kansas....... 297
Insects (injurious) in Oklahoma.... 65
Insects of Southern Alaska.......... 294
Instruments........................ 567
International Botanical Congress... 279
International Congress of Americanists........................300 579
International Congress of Archeology and Ethnology, sketches of 300, 302........................308 579
International Congress of Prehistoric Archeology and Paleontology, 11th meeting............ 1024
International Congress of Anthropology........................ 1034
International Congress of Zoology 312 764
Invertebrate fossils of the Trinity Division........................ 1001
Invertebrate Paleontology of the Texas Cretaceous................ 1084
Iowa Geological Survey..........985 1078

Ipomoea carletonii...................... 280
Ischyodus egertonii...................... 472
Isomorphism.............................. 386
Iva frutescens........................... 1089

JADE in Burmah........................... 561
Joessel, J. G............................ 192
Joessel, J. G............................ 411
Johns Hopkins Marine Biological Laboratory...................... 491
Johnston-Lavis, M........................ 490
Joint Formation among the Invertebrata, B. Sharp........................ 89
Journal of Geology....................... 360
Juba, ascent of.......................... 730
Jura and Trias in Taylorville, California................................ 470

KACHINS and the Irawadi.................. 462
Kiaer, F................................. 917
Kidney of Amphiuma....................... 154
Kinderhook Fauna......................... 471
Kingsley, J. A., Record of North American Zoology............................ 85
Kinosternidae............................ 673
Kinosternum louisianae................... 676
Kinosternum pennsylvanicum............... 677
Knop's Geological History of Baden...... 1089
Koksharoff, N. I......................... 315
Korschelt, D. E.......................... 845
Kuntze's Revisio Generum Plantarum, etc., III..................... 1010

LAGANUM decagonale....................... 39
Lake Basins.............................. 561
Lancaster, J., Flight of Birds........... 20
Lancelet from the Bahamas................ 830
Language versus Anatomy in determining Human Races.................. 579
Larus ridibundus......................... 66
Larynx of Batrachia...................... 154
Lateral Line of Siluroids................ 477
Lateroversion of the Ophidian Heart...... 860
Laurentian and Huronian Rocks north of Lake Huron, relations of........................ 996
Laurentian of the Ottawa District........ 998
Lavas of a Tertiary Cone................. 275
Lawrence, G. N., Bibliography of......... 317
Leaia mitchellii......................... 271
Lectures at the Paris Museum............. 592
Lecythium hyalinum....................... 484
Leeches.................................. 484
Lee, S. F., Review of Ribot's Diseases of Personality.................. 83
Lee, F. S., Review of Romanes' Darwin and after Darwin...................... 31
Legendary Evolution of the Navajo Indians, T. S. Van Vleet............. 69
Lepidodendron australe................... 1001
Lepidodiscus milleri..................... 38
Lepidolite...................... 1090 1091
Lepidoptera in the Edwards collection of Insects, list of............... 297
Lepidosiren paradoxa..................... 920
Lepidosteus suessoniensis................ 478
Lepteces ornatus......................... 830
Leptolepis affinis Sauvage............... 657
Leptolepis antissiodorensis Sauvage...... 657
Lesquereux's Flora of the Dakota Group... 1079
Leucite-Tephrite of Hussak............... 562
Leukart "Festschrift".................... 411
Libytherium maurusium.................... 147
Lichtenthaler, G. W...................... 491
Light, Wright's.......................... 456
Limpets, locomotion of................... 51
Liobunum hemisphericum................... 389
Liobunum ventricosum Wood................ 541
Liobunum ventricosum hyemale Weed........ 525
List of Plants rarely found in Staten Island.................................. 589
Lithium Monsters......................... 1099
Lithographic limestone................... 900
Lithophysae in the Rocche Rosse.......... 382
Littorina litorea........................ 1112
Locusts.................................. 681
Loess in Southern Russia................. 269
Loew, Prof............................... 1115
Longipennes, classification of, R. W. Shufeldt........................... 238
Lorsen, Prof. K. A....................... 593
Loxonema winnipegense.................... 662
Lungula monesii.......................... 736
Lycaenid larva an Atriplex, C. H. T. Townsend........................... 1104
Lydekker, R.............................. 1088

MACACUS tolosanus........................ 150
Macdougal, D. T.......................... 917
MacMillan, C., The Probable Physiognomy of the Cretaceous Plant Population......................... 836
Macleay, Sir William, scientific memorial volume in honor of............. 1089
Macrochelys lacertina.................... 742
Madagascar fauna......................... 282
Magothy formations....................... 662
Maioid Crabs in the National Museum..... 830

Malchite, description of 380
Mammalia (fossil) in Southern Patagonia 439
Mammals from the Galapagos Islands 394
Mammalia from the Pits of Gargas 560
Mammalia News 672
Mammals of the Deep River Beds, W. B. Scott 659
Mammals, Mexican 742
Man and the Glacial Period, Wright's 550
Man of Spy 321
Mantle of Ascidians 486
Maori dentition 321
Marine Biological Laboratories of Europe, B. Dean 697
Marine Biological Laboratory at Wood's Holl 595 841
Marine Laboratories of Europe, B. Dean 625
Marsipobranchs, position of 283
Martite 44 1092
Mastodon borsonii 561
Mastodon oligobunis 473
McGee, W. J 1038
Measure of Civilization 174
Mechanical Evolution of the Metapodial Keels of Diplarthra, J. L. Wortman 421
Mechanical Genesis of the Scales of Fishes 391
Medals awarded by the Columbian Exposition at Madrid 316
Mediterranean Sea, depths of 262
Medusa from Lake Tanganyika 571
Megaladapis madagascariensis 1002
Megascops 638
Melanostibian 901
Melibocus Massiv" and its Dyke Rocks 563
Melilite 384
Membranes of the Sea Urchin Egg 397
Memoirs of the National Academy of Sciences, Vol. V 243
Meniscotherium 128
Mental Evolution, Calderwood's 654
Mercer, H. C., Trenton and Somme Gravel Specimens compared with Ancient Quarry Refuse in America and Europe 962
Merz, K. S. von 317
Mesabi Iron District 270
Mesohippus 429
Mesoreodon chelonyx 661
Mesoreodon intermedius 661
Mesosauria, classification of 36
Mesosauria of South Africa 85
Mesosaurus pleurogaster 85
Mesosaurus tenuidens 35
Mesothyra oceana 796
Mesozoic Echinodermata of the United States 1079
Mesozoic News 38, 150, 271, 472, 560, 662, 737 1001 1084
Metacoceras dubium Hyatt 867
Metasperma of the Minnesota Valley, MacMillan's 365
Metatoceras cavatiformis Hyatt 866
Method of injecting the Blood vessels of Birds, W. S. Miller 582
Mica Perodite 273
Micro-chemical Analysis 903
Micro-chemical Reactions 387
Microscopy 175, 405 583 1026
Miller, Prof. A. M
Miller, W. S., Method of injecting the Blood vessels of Birds 582
Millerite 1092
Mineralogical News 43, 276 903 1006
Mineralogy and Petrography 40, 272, 380, 562, 898 1003 1087
Mineral Resources of the United States, 1889 and 1890 143
Mineral Resources of the United States, 1891 816
Mineral Syntheses 45 567
Minerals from the Diamond fields of Brazil 883
Minerals, physical properties of 1092
Miocloenus pentacus 377
Miocloenus turgidus 877
Mirabilite changed to Thenardite 1006
Möller, Dr. H 1115
Molluscan News 484
Molluscan Ova, methods of preparing 1026
Mollusks, cretaceous 38
Mollusks of Louisiana 944
Mollusks of the Water Mains of Paris 1094
Monasite 384
Monochoria parisiensis 271
Monocladodus clarkii 1083
Monocladodus pinnatus 1083
Monstrosities, exhibition of 450
Moon's Face 734
Moore, T. J 412
Moore, C. B 605 708
Moore, C. B., Shell Heaps of the St. John's River 8, 113 605 708
Moore, J. P., Eggs of Pityophis melanoleucus 878, Errata 1115
Moraines in Chili 473
Morenorite 44
Morgan, H. A 170

Morphology of Root Tubercles of Leguminosae, A. Schneider... 782
Mosses and Lichens, Canadian..... 476
Mouth Parts and Thorax of Insects and Chilopods, N. Banks...... 400
Msidi, death of... 732
Mud Avalanches in the Mustagh Mts... 1082
Mummied Child from the Cliff Dwellers... 437
Mus aquilus... 56
Museum for Chicago... 886
Musteline from the John Day Miocene... 658

NAIADACEAE, Morong's....... 475
Naiads, Morong's... 569
Names of Fossils... 37
Nansen's Polar Voyage... 263
Naples Marine Biological Laboratory... 136
Naples Zoological Station... 491
National Academy of Science....... 585
Natrolite...903 1007
Naturlichen Pflanzenfamilien, Engler and Prautl's... 49
Nebalia bipes... 799
Nebalia geoffroyi... 800
Nebraska Academy of Sciences..... 80
Nebria sahlbergii Fisch... 164
Nectonema agile... 484
Neocene in the Sierra Nevada...... 1084
Neotoma pennsylvanica... 574
Nepheline and Leucite Rocks of Brazil... 274
Nephrida of Amphioxus... 288
Nephrite of New Zealand... 582
Nest Building Frog... 67
Neusiedler Lake... 730
Neusticosauria... 86
Newark System... 987
Newberry, J. S... 83
Newberry Library of Geology...... 164
New Discoveries in the Fossil Mammalia of Southern Patagonia, F. Ameghnio... 439
New Guinea, travels in... 466
New Mexico Society for the Advancement of Science... 310
New Minerals...566 900
New York Academy of Sciences 80, 182, 308, 409...488 586
Nickle arsenide... 885
Nile, sources of... 731
Ninth International Congress of Americanists... 838
Noctuidae, North American... 1106
Noll, F. C... 411
Norian Rocks of Canada... 656
Norites in the Eastern United States... 1008
North America during Cambrian Time... 734
Nosean... 42
Notes on the Cochineal Insect, T. D. A. Cockerell... 1041
Notes on the Mollusks from Northwestern Louisiana and Harrison County, Texas, T. W. Vaughn... 944
Notropis albeolus... 152
Notropis heterolepis... 152
Notropis jordanii... 592
Notropis reticulatus... 152
Notropis scopiferus... 153
Notulinia noctula... 53
Novaculites of Arkansas... 42
Noxious Insects, Fernauld's bulletin of... 296
Nubecularia jonesiana... 560
Nutting, C. C., Biological Expedition sent out by the Iowa State University to the West Indies and to the Florida Keys....... 894
Nutting, C. C., What is an Acquired Character... 83

OBSERVATORY in West Greenland... 468
Odontophorus consobrinus.... 837
Officers of the Nottingham Meeting Brit. Ass. Adv. Sci... 593
Olivine... 1008
Omasaurus phillipsi... 1001
Oolite, formation of... 34
Oneonta and Chemung Formations in Eastern Central New York. 558
Onychomys ramona... 833
Ophibolus doliatus Linn... 1066
Opossums on Staten Island... 1108
Optical Anomalies... 385
Organism produced sexually without characteristics of the Mother, Th. Boveri... 222
Origin of the Human Face... 1095
Ornithology of Washington and British Columbia... 671
Ornithostoma... 1085
Orpiment... 1006
Orthography, reform in... 238
Orthopterous Insects of the Galapagos Islands... 1094
Oryzomys baurii... 39[illegible]
Osaun, Dr....
Osborn H., Note on Trichodactylus xylocopæ... 1021

Osborn, H. F., The Ancylopoda, Chalicotherium and Artionyx. 118
Osborn, H. F., Recent Researches upon the Succession of the Teeth in Mammals.............. 493
Osmic acid solutions, restoration of............................. 175
Ostracoda, fossil......................... 1002
Ostracoda, silurian........................ 38
Ostrea munsonii......................... 1085
Ostriches, African and South American.................................. 1086
Otocoris alpestris Linn................ 587
Otaria jubata.............................. 894
Ottrelite bearing Conglomerate from Vermont........................382 1003
Owen, Richard.......................... 83

PALAEASPIS americana......... 375
Palestine, geology of........... 267
Paleolithic Man.................. 1086
Palæortyx grivensis.................... 737
Palæortyx maxima.................... 737
Palæosaccus............................. 1084
Palæotermes ellisii...................... 150
Paleontology 34, 144, 267, 375, 380, 469, 558, 650, 734, 813, 996 1082
Paleozoic Crustacea..................... 1115
Paleozoic Formations of Southern Minnesota........................ 144
Paleozoic Group of Georgia......... 1078
Paleozoic News 37, 149, 270, 472, 560, 662, 736...............1001 1084
Pan-American Medical Congress... 1088
Pamirs, Travels in the................ 257
Pammel, L. H., Recent Books on Bacteriology....................... 544
Pantosteus columbianus.............. 151
Pantosteus discobolus................. 672
Pantosteus generosus.................. 672
Pantosteus jordanii..................... 672
Pantosteus plebeius.................... 672
Paraffine cooling........................ 407
Parallelism in Brachiopoda (Magellania series)........................ 604
Parasites, Leidy collection.......... 683
Parasitism............................... 346
Parfitt, Edward......................... 593
Parmacochlea fischerii................ 484
Parus hudsonicus...................... 671
Parus columbianus..................... 671
Patella vulgata.......................... 51
Patton, Dr. W........................... 917
Pavo domesticus....................... 66
Pear-Tree Psylla, Slingerland's experiments with the........... 293
Peary Expedition of 1893.........26 489
Pedal Skeleton of the Dorking Fowl.............................. 156
Peik-Tu-Shan, a visit to.............. 461
Pelias berus............................. 299
Pelophilus madagascariensis......... 279
Penfieldite................................ 45
Pentamerus decussatus................ 741
Perognathus merriamii................ 573
Peronospora echinospermi.......... 474
Persia, map of.......................... 465
Petrographical News, 42, 274, 899, 1005 1088
Petrography 40, 272, 380.......562 898
Petrography of the Abukuma, Japan................................. 562
Petrography of Hokkaido, Japan... 380
Pfitzner, Prof. W....................... 411
Phalangiidae, notes on, C. M. Weed.............................. 294
Phallogaster saccatus.................. 280
Phaneropleuron curtum Whiteaves. 817
Phascolomys mitchellii............... 88
Phascolomys platyrhinus............. 38
Philosophical Congress............... 1028
Philosophy of Flower Seasons, H. L. Clarke.......................... 769
Pholidophorus germanicus.......... 150
Phonolites of the Hegan............. 1087
Phylogeny............................... 586
Phylogeny of an Acquired Characteristic, A. Hyatt................. 865
Physiology, Jenkins'................... 654
Piersol's Histology...................... 1077
Pinicola enucleator Linn............. 587
Pityophis melanoleucus.............. 878
Plagiaulax dawsonii................... 150
Planorbis contortus.................... 151
Plants of the Bahamas, Jamaica and Grand Cayman............. 664
Plants, fossil from Wichita Beds... 150
Plastysternidae.......................... 674
Plastysternoidae........................ 674
Plectrophenax nivalis Linn.......... 587
Pleistocene Deposits of Russia...... 819
Pliocene (Marine) Beds of the Carolinas............................ 471
Podabrus xanthoderus Lec.......... 165
Poikilite.................................. 900
Polar Regions, explorations in...... 468
Polar Regions, travels in............. 268
Polidophorus gaudryi................. 657
Polybasite................................ 43
Polychaetes, eyes of................... 388
Polygonum mexicanum............... 281
Polygonum pringlei.................... 281
Pontine Marshes, scheme for reclaiming............................ 730
Popenoe, Prof........................... 170
Popular Botany......................... 653

Porphyry breccia........................ 1005
Portage Stage... ....1001 1084
Postage on Natural History Specimens................................ 845
Post-Laramie Beds of Middle Park, Colorado.................-.......... 471
Pound, R., Review of Kuntze's Revisio Generum Plantarum, Etc., III... 1010
Pound, R., Symbiosis and Mutualism in Lichens..................... 509
Prantl, Prof. R.......................... 593
Pratt, Miss Anna........................ 917
Preserve for New Zealand........... 360
Prince, E. E.............................. 317
Princeton Meeting of Societies...... 135
Primospina E. & B....................... 669
Priority in Nomenclature............. 134
Prize for best method of destroying pernicious Insects in the Forests of western Prussia......... 1115
Probable Physiognomy of the Cretaceous Plant Population, C. MacMillan........................... 336
Proceedings of Scientfic Societies 80, 176, 306, 409, 488, 585, 682, 762, 913...............1028 1108
Prodomus of a new system of the non-venomious Snakes, E. D. Cope................................ 477
Proganosauria..............................
Prosopon etheridgei.................... 271
Protocaris marshii....................... 800
Protoceras celer Marsh................ 137
Protodus jexii.............................. 149
Protogonodon, systematic position of, C. Earle........................ 377
Protohippus placidus.................. 812
Protolemus elegans..................... 560
Protolemus paradoxoides... 560
Protozoan News.......................... 484
Prilomelane................................ 384
Psychical Science Congress......... 1029
Psychology 65......................171 298
Psylla pyricola...... 293
Psyllobora 20 maculata Say......... 165
Pteranodon................................. 1085
Pterodactyls from Kansas.........37 1085
Pteropodus E. & B....................... 670
Pterosauria, classification of......... 37
Pterostichus riparius Dej............ 164
Ptiolite 43
Pupa of Argyramoeba oedipus Fab., description of...................... 60
Puparium of Blepharipeza, description of................................ 204
Puparium of Jurinia..................... 576
Pyrenite..................................... 1008
Pyrophanite........ 277
Pyroxenite.................................. 1088

QUANTITY of Human Life, J. L. Williams.......................... 193
Quarterly Bulletin of the University of Minnesota........ 412
Quartz-Gabbro in Maryland......... 383
Quercus brittonii Davis............... 587
Quercus ilicifolia Wang.............. 587
Quercus nigra L...... 587
Quicksilver Ore Deposits............ 99

RABBIT'S Feet, modification of. 672
Radiolaria archean.............. 149
Radiolaria, paleozoic......... 149
Radiolites davidsonii.................. 1085
Rampheoleon spectrum. 1095
Rampheoleon kerstenii............... 1095
Ranunculus repens..................... 280
Recent Books on Bacteriology. L. H. Pammel.............................. 554
Recent Books and Pamphlets 28, 137, 240, 361, 455, 544, 650, 724, 808. 889.................982 1074
Recent Literature 31, 140, 243, 364, 455, 547, 653, 727, 811, 892..................................985 1077
Recent Researches upon the Succession of the Teeth in Mammals, H. F. Osborn............. 493
Recent Studies in Carnivorous Plants, J. G. Smith.............. 443
Reciprocal Changes in Polymorphous bodies............... 1008
Record of American Zoology....... 85
Reithrodontomys pallidus............ 835
Relationships and Distribution of the North American Unionidae with notes on the West Coast Species, C. T. Simpson......... 353
Relationship of the species usually united uuder the generic name Sebastodes, C. H. Eigenmann and C. H. Beeson............... 668
Report of the Minnesota Geological and Natural History Survey, 1891............................ 811
Report of the U. S. Geological Survey, 1889–90, Part I....... 990
Reptiles and Batrachians of Wisconsin................................... 742
Reptiles from the Elgin Sandstone. 376
Reptiles, fossil from the Parana, E. D. Cope........................ 376
Reptilian News........................... 285
Reptiles from Texas.................... 672
Review of Beddard's Animal Coloration, E. D. Cope.............. 371

Review of Cary's Study in Foot Structure, E. D. Cope.......... 248
Review of The Death Valley Expedition, E. D. Cope........... 990
Review of Earle's Species of Coryphodontidae, E. D. Cope...... 250
Review of Fritsch's Fauna of the Gaskohle of Bohemia, E. D. Cope........................... 1079
Review of Forsyth-Major and Röse's Theory of Dental Evolution, E. D. Cope............... 1014
Review of Haeker's Cleavage in Aequoria forskalea.............. 58
Review of Humphrey's Saprolegniaceae of the United States, C. E. Bessey...................... 664
Review of Keeler's Evolution of the North American Land Birds, E. D. Cope............... 547
Review of MacMillian's Metasperma of the Minnesota Valley, C. E. Bessey...................... 365
Review of Ribot's Diseases of Personality, F. S. Lee.............. 33
Review of Romanes' Darwin and after Darwin, F. S. Lee........ 31
Review of Spalding's Guide to the Study of Common Plants, C. E. Bessey........................... 988
Review of Wright's Man and the Glacial Period, E. D. Cope... 550
Rhampholeon brachyurus............ 286
Rhampholeon platyceps.............. 286
Rhinocaris columbina............795 797
Rhoads, S. N., Descriptions of 4 Rodents from California....... 831
Rhoads, S N., Description of Synaptomys stonei.................. 53
Rhyolite in Maryland and Pennsylvania.................................. 273
Rhytina gigas Linn..................... 490
Roccus linneatus.......................
Rocks occurring at Cingolina....... 900
Rocks of the Hardt Mts.............. 1089
Rocks of a New Island off Pantelleria.................................. 1088
Rocks of Odenwald.................... 1089
Rock Separations........................ 568
Rocks from Siberia..................... 381
Rocks from Southern Borneo....... 899
Rocks of the Thalhorn................. 272
Rocks of the Valley of Miñor, Spain.................................. 1089
Rodents from California.............. 831
Rosenbusch's Volume on Minerals. 567
Rothrock, J. T........................... 83
Rubellite.................................. 1091
Russell, H. L., Bacteriology in its General Relations..........847 1050

SABACON spinosus................. 575
Saccharomyces...................... 685
Sacken, Baron Osten............ 64
Salt Crystals.. 1006
Saprolegniaceae of the United States....................................... 664
Sarasin, M. M............................... 593
Sarcolestes leedsii........................ 1002
Scaumenacia curta........................ 817
Schaaffhausen, Prof. H.............. 412
Schists of Southern Berkshire, England.................................... 1087
Schneider, A., Morphology of Root Tubercles of Leguminosae..... 782
Scientific News 82, 191, 314, 410, 489, 592, 683, 764, 844, 917, 1038 1115
Scientific Publications................ 1072
Sciurus undulatus....................... 56
Scott, W. B., The Mammals of the Deep River Beds................ 659
Scott, W. B., A New Musteline from the John Day Miocene... 658
Searles, E. F., Bequest of........... 316
Sea-urchin Egg.......................... 743
Sebastichthys Gill....................... 669
Sebastodes 668
Sebastodes Gill........................... 670
Sebastosomus Gill....................... 670
Sediments 149
Seitz, Dr. A............................... 844
Selenia illustraria....................... 1016
Selenite...................................... 1091
Semper, Prof. Carl......... 845
Serropalpus barbatus Schall.......... 166
Sesquicentennial of the American Philosophical Society............ 542
Sharp, B., Joint Formation among the Invertebrata.................. 89
Sharks.......................................
Shasta-Chico series...................... 663
Shell Heaps of the St. John's River Florida, C. B. Moore 8, 113, 605 708
Shimek, Prof. B........................... 317
Shufeldt, R. W., Classification of the Longipennes.................. 233
Shufeldt, R. W., Ridgway on the Anatomy of Humming Birds and Swifts.—A Rejoinder...... 367
Shrubsole, G. W......................... 917
Siberia, description of northeastern. 464
Simpson, C. T., On the Relationships and Distribution of the North American Unionidae.... 356
Sitomys herronii.......................... 832

Sitomys major.... 831
Smilax rotundifolia.... 185
Smilodon fatalis Leidy.... 897
Smilodon gracilis Cope.... 897
Smith, J. G., Recent Studies of Carnivorous Plants.... 413
Snakes, feeding of.... 298
Sodalite-Syenite from Montana.... 568
Solenopora compacta Billings.... 786
Solidago missouriensis.... 280
Sollas, Dr. J.... 917
Spade-foot, new from Texas.... 155
Spaerechinus granulatus 227...228 229
Spalding's Guide to the Study of Common Plants.... 988
Sparrow, English, mortality of.... 239
Spea laticeps Cope.... 155
Specific Names, decapitalized.... 821
Specific Names, personal.... 822
Specimens in the Mails.... 979
Spencer's Paleozoic Group of Georgia.... 1078
Spermophilus.... 1095
Spessartite.... 903
Spherulites of andalusite.... 275
Sphoerechinus granularis.... 743
Spiders from New Mexico and Arizona.... 679
Spore-forming species of the genus Saccharomyces, J. C. Bay.... 685
Stainton, H. T.... 814
Star-fish larva. Field's.... 288
Staten Island Natural Science Association 182, 488....586 1108
Staurotypidae.... 678
Stemonitis virginensis.... 474
Steneofiber montanus.... 660
Stenopus hispidus.... 243
Stereosternum tumidum.... 85
Stibarus obtusilobus.... 148
Stichodactyinae.... 829
Stone, W., description of Evotomys gapperi rhoadsii.... 54
Strauch, Alexander.... 1038
Stringocephelus zone in Manitoba.. 471
Strix flammea.... 66
Strix sanctialbani.... 737
Sumiro Accadians of Chaldea, Legends of, A. Bodington 14, 105, Errata.... 410
Sundtite.... 900
Swifts and Humming-Birds.... 573
Sylvia hortensis.... 65
Synaptomys stonei, description of. 53
Syneta albida Lec.... 166
Symbiosis and Mutualism in Lichens.... 509
Symmorium and the Position of the Cladodont Sharks, E. D. Cope. 999
Synthesis of the Members of the Sodalite Group.... 277
Systematic position of the Kiwi.... 392

TAENIOPTERIS missuriensis. 662
Tahitian dentition.... 321
Talc.... 902
Tapir.... 428
Temnochilus crassus.... 867
Tennantite.... 43
Terraces.... 471
Terrapene carolina L.... 677
Terrapene major Ag.... 677
Terrapene mexicana Gray.... 677
Terrapene ornata.... 678
Terrapene triungius Ag.... 678
Termitophilus Insects.... 400
Tertiary Insects from Colorado and Utah.... 558
Testudinata.... 672
Testudinidae.... 675
Testudinoidea.... 675
Tetrabelodon serridens.... 812
Tetrabelodon shepardii Leidy 473, 493 812
Texas Geological Survey, 1891.... 142
Textularia decurrens.... 560
Textularia serrata.... 560
Thecla calamus.... 1018
Thomas, M. B., The Androchonia of Lepidoptera.... 1018
Thomomys.... 387
Thomomys bulbivorus.... 1096
Thomomys aureus.... 837
Thomomys fossor.... 837
Thomomys monticolus.... 837
Thomomys toltecus.... 837
Tibet, exploration of.... 465
Titanotherium Beds, J. B. Hatcher 204
Totanus majori.... 737
Tourmaline.... 903
Townsend, C. H. T.... 170
Townsend, C. H. T., Description of a Case-worm from Grand Cañon.... 166
Townsend, C. H. T., Description of Cecidomyia atriplicis.... 1021
Townsend, C. H. T., Description of the Pupa of Argyramoeba oedipus Fab.... 60
Townsend, C. H. T., Description of Puparium of Jurinia.... 576
Townsend, C. H. T., Hymenopterous Gall on a Creosote Bush.... 905
Townsend, C. H. T., Lepdopterous gall on Bigelovia.... 680

Townsend, C. H. T., Lycaenid larva on Striplex.................. 1104
Townsend, C. H. T., Puparium of Blepharipeza.................. 402
Townsend, C. H. T., Spiders collected in New Mexico and Arizona 679
Townsend, C. H. T., Tineid Caseworm from the Grand Cañon.. 402
Townsend, C. H. T., Twig Galls on Populas fremontii............ 904
Townsend, C. H. T., Wooly Leaf gall on Oak near Grand Cañon. 905
Trachytes and Andesites of the Siebengebirge..................... 1003
Tremolite.................................. 276
Trenton and Somme Gravel Specimens compared with Ancient Quarry Refuse in America and Europe, H. C. Mercer.......... 962
Trichobaris trinotata.................... 578
Trichocactylus xylocopae in California.............................. 1021
Trilobite from the Skiddaw Slates. 270
Trilobite, larval......................... 1001
Triton cristatus.......................... 290
Triton palmatus.......................... 290
Tropidoclonium lineatum............ 156
Tunicate Studies.......................... 51
Turdus fuscescens........................ 185
Tuscaloosa Formation................ 38
Tuscan Archipelago.................. . 736
Typhlogobius californiensis.......... 573
Typhlops curtus.......................... 56
Typhlotriton speloeus.................. 287

UCAYALI River, exploration of. 256
Ulex europoeus L................ 183
Uline, E.......................... 918
Umbia limi................................ 588
Unionidae, North American......... 353
Uplifts in the California Sierras.... 147
Uranatile................................... 1006
Uranophane................................ 1006
Ursus arctos................................. 271
Ursus speloeus............................ 560

VAMPYRUS spectrum............ 53
Vanellus cristatus............... 65
Van Vleet, T. S., Legendary Evolution of the Navajo Indians.................................... 69
Variation in the snakes of North America........................... 285
Variolitic Dyke in Ireland.......... 1003
Vaughn, T. W., Notes on Mollusks from Northwestern La. and Harrison County, Texas.. 944
Vegetable growths as evidence of purity or impurity of Water... 281
Vermes, news.............................. 484
Vertebrate Fauna of the Ordovician of Colorado,........................ 268
Vertebrate News......................... 1096
Vertebrate Paleontology of the Llano Estacado, Texas, E. D. Cope................................ 811
Vesuvianite................................. 44
Vetter, Dr. B............................ 412
Viallanes, Henry......................... 844
Vine, G. R..... 917
Virchow, Prof..............................
Vision in a girl 6 years of age, operated upon for double Congenital Cataract 171
Volcanic Dust in Texas.............. 663
Volcanic Eruptions in California... 813
Volcanic Rocks of the Andes 898

WALKER, A. S., expedition of...... 464
Ward, Dr. H. B 844
Washington Anthropological Society 81, 187, 410, 488.....682 737
Washington Biological Society 81, 187, 410, 488, 591 ....682 1114
Washington Geological Society.... 591
Webster, C. L., Among the Cliff-Dwellers............................ 435
Weed, H. E................................ 170
Weed, C. M., An American species of Sabacon................... 574
Weed, C. M., Cinnamon Harvest Spider and its Variations...... 534
Weed, C. M., The Gipsy Moth Commission........................ 750
Weed, C. M., North American Cosmetidae............................ 574
Weed, C. M., Notes on Ohio and other Phalangiidae.............. 294
Weed-seeds, Halsted's................ 475
Weir, Jas., Animal Intelligence.... 933
Westwood, J. O.......................... 192
Wetlsloin, R. von...................... 317
Whartonite................................. 566
Wheatland, Dr. Henry................ 410
White Clays of the Ohio Region... 148
Wickham, H. F., Descriptions of Coleoptera from the Northwest...................................... 164
Willams, J. L., The Quantity of Human Life......................... 198
Wolle's Desmids......................... 47
Woman of Spy............................ 321
Wood-Mason, James.................. 845
Woodland of the Southwest, Lummis'.. 364

Woodward, A. Smith................ 411
Wooly Alder Aphis...............400 402
World's Congress Auxiliary of the World's Columbian Exposition of 1893.............................. 762
Wortman, J. L., A New Theory of the Mechanical Evolution of the Metapodial Keels of Diplarthra.............................. 421

XENOTIME........................ 901
Xantusia henshawii........... 837

ZAMITES montanensis........... 1085
Zander, Dr....................... 844
Zapus insignis........................... 672
Zeuzera oesculi Linn................. 586
Zeuglodon caucasicus..................... 663
Zoological News 56, 285, 484, 573 671, 741.......................837 1096
Zoological Congress.................. 1032
Zoologists and the American Association............................... 887
Zoology 51, 151, 282, 388, 477, 571, 667, 741................829 1014
Zoology, Kennel's.......................... 893
Zoology of the Lower Saskatchewan River......................... 741
Zunyite.................................... 901
Zuyder Zee, reclamation of......... 780

THE

AMERICAN NATURALIST

VOL. XXVII. January, 1893. 313

THE GASES IN LIVING PLANTS.[1]

BY J. C. ARTHUR.[2]

The present state of knowledge regarding the kinds, sources and movement of gases in plants does not constitute a completed volume. There is much yet to be learned, old views are to be corrected, and alleged facts are to be more firmly established. The subject is thoroughly modern, the first writer to give any connected and intelligent account of the behavior of gases in connection with living plants being De Saussure in his brilliant and epoch-making work describing his chemical researches upon vegetation, published in 1804.

THE COURSE OF DISCOVERY UP TO 1865.

The various life functions of plants have been slowly established by first assuming them to be individually the same as those of animals, and from this basis gradually evolving their true nature. The early naturalists saw nothing in plants that suggested lungs or the movement of air, and it was not till the time of Malpighi, 1671, that breathing was supposed to have any part in the plant economy. He saw in the wood vessels, known then and long afterward as spiral vessels, an analogous set of organs to the tracheæ of insects, and therefore believed them to have the same office. His views were accepted by the Englishmen, Grew and Ray, who wrote about the same time, but found no supporters in Germany or France. The views of Malpighi, who in many respects was far in advance of the other botanists of his age, fell into obscurity, insomuch that even the existence of ducts was finally denied.

---

[1] Read before the Biological Section of the Amer. Assoc. Adv. Science, in Washington, August, 1891.

[2] D. Sc. Professor of Vegetable Physiology and Pathology, in Purdue University, Indiana.

The subject was not revived until 1715, when Nieuwentyt demonstrated the presence of air in plants by placing sections of stems in water under an air pump. The demonstration was better performed by Christian Wolff, who was a philosophical naturalist of much insight. He placed leaves, wood, and other parts of plants, in water, freed from air, under the air pump, and after seeing the bubbles rise from the tissues as the air was exhausted from the receiver, he allowed the air to re-enter the receiver, and found that the tissues were at once filled with water, and that some kinds were thereby made so heavy as to sink.

In England, a few years afterward (1727), Stephen Hales, the real founder of experimental vegetable physiology, repeated and improved upon the air pump experiments, but used his knowledge to explain the life processes in a different manner from his predecessors. He combined the fact that gases are recovered from plants by dry distillation and fermentation to support a well arranged theory of the use of gases in forming the solid parts of plants. The use of gases by plants was, therefore, according to Hales, a part of the subject of the nutrition of plants.

But this small advance led to no further developments, and was again lost sight of for many years. After nearly half a century, in 1771, Priestley hit upon a discovery which, coming as it did only three years before the discovery of oxygen, and only shortly before the re-organization of chemical theories by Lavoisier and others, proved very fruitful.

Priestley's discovery was simple enough, amounting only to the fact that plants give off oxygen. He tells of his discovery in an interesting way, and I, therefore, quote a few paragraphs from his communication to the Royal Society, announcing the matter:

"The quantity of air which even a small flame requires to keep it burning is prodigous. It is generally said that an ordinary candle consumes, as it is called, about a gallon in a minute. Considering this amazing consumption of air, by fires of all kinds, volcanoes, etc., it becomes a great object of philosophical inquiry, to ascertain what change is made in the constitution of the air by flame, and to discover what provision there is in Nature for remedying the injury which the atmosphere receives by this means.

"I flatter myself that I have accidentally hit upon a method of restoring air which has been injured by the burning of candles, and that I have discovered at least one of the restoratives which Nature employs for this purpose. It is vegetation. * * * One might have imagined that, since common air is necessary to vegetable as well as to animal life, both plants and animals had affected it in the same manner, and I own I had that expectation when I first put a sprig of mint in a glass jar standing inverted in a vessel of water; but when it had continued growing there for some months, I found that the air would neither extinguish a candle nor was it at all inconvenient to a mouse which I put into it. * * * Finding that candles burn very well in air in which plants had grown a long time, and having had some reason to think that there was something attending vegetation which restored air that had been injured by respiration, I thought it was possible that the same process might also restore the air that had been injured by the burning of candles. Accordingly, on August 17, 1771, I put a sprig of mint into a quantity of air, in which a wax candle had burned out, and found that on August 27 another candle burned perfectly well in it. This experiment I repeated, without the least variation in the event, not less than eight or ten times in the remainder of the summer."

Had Priestley had the good fortune to have set his jar containing green sprigs into direct sunlight, he would have made an additional discovery of almost equal importance. But the world did not wait long till Ingenhousz went over the ground and discovered (1779) that light was an essential factor in restoring air, and that by the aid of sunlight he could perform in a few hours the experiments which took Priestley five or six days.

In 1800 Senebier added the discovery that plants obtain all their carbon from carbon dioxide, but fell into the error of supposing that part, at least, of this gas was taken up by the plant through its roots, an error that has proved extremely tenacious, existing in our text books to the present day, although repeatedly and fully disproven.

We have now arrived at the time of De Saussure (1804), who, with his superior chemical knowledge, placed the whole subject in excellent shape. He distinguished between carbon assimilation and true respiration. He dealt with the subject quantitatively, and showed that there was a definite relation between the carbon dioxide taken up by the plant and the oxygen evolved by the action of light. He clearly pointed out that the presence of oxygen was as essential to the growth of plants as to animals, the most active parts, such as green leaves, opening flowers, etc., requiring the most, and that this requirement had no relation to the presence of light.

De Saussure also pointed out that while plants receive their supply of carbon dioxide for assimilation, and oxygen for respiration directly from the atmosphere, yet the nitrogen, which is an essential constituent of their organization and by far the most abundant gas in the atmosphere is not utilized by plants in the gaseous form.

Having now established that plants contain gases, that these gases are the same as those of the atmosphere surrounding the plant, that oxygen and carbon dioxide are made use of in their gaseous forms in the life processes of plants, while nitrogen as a gas is not actively connected with the life of plants, and having established these facts with a wealth of accurate experiment and logical deduction that permitted no doubt of the truth, it was left to De Saussure's successors to elaborate the structure which he had so ably built, without being called upon to again readjust the foundations.

It was over thirty years before a work of importance in this line again appeared. In 1837 Dutrochet published his anatomical and physiological memoirs, in which he carefully studied the structure of vegetable organs as well as their functions. He was the first to rightly point out the relations of the cavities in plants to the movement of gases in respiration, that only cells with chlorophyll are able to decompose carbon dioxide, and to distinguish sharply between respiration and assimilation. But although he recognized the essentially different character of the two processes, respiration and assimilation, yet he used the erroneous and absurd nomenclature of the time, and called them nocturnal and diurnal respiration. The weight of his example did much to fix the terms in popular usage, where they still persist, in spite of the protests of every able investigator and writer upon the subject since; and even though the matter was set right by Garreau in 1851, who did admirable work upon plant respiration.

In 1865 appeared the handbook of experimental physiology of plants by Julius Sachs, the founder of the modern school of vegetable physiologists. The work was comprehensive, well balanced, and replete with clear ideas of the theoretical bearing and logical association of the facts.

The author's laboratory at Würzburg, where he shortly became established, has been the school from which most of the great plant physiologists of the present have received instruction and from which all have drawn inspiration. It is sad that its doors should now be darkened by the mists that have gathered over the intellect of its honored director.

In the handbook of Sachs a chapter is devoted to each of the three branches of the subject; aeration, or the movement of gases in the plant; respiration, or the action of atmospheric oxygen; and the effect of light upon vegetation, chiefly in assimilation. Each of the topics is treated in a clear and masterly manner.

NATIONALITY OF DISCOVERERS AND WRITERS.

Having traced the growth of knowledge regarding the vital relations of gases to plants up to the time when it was possible to present the subject in a reasonably complete and well balanced manner, it will be more satisfactory to drop the chronological method of treatment, and to outline the salient features of the subject as they are understood at the present time. Before doing so, however, it will not be unprofitable to glance for a few moments at the parts which the several nations have played in this growth of knowledge, and at the reciprocal influence which has been exerted upon the teachers of those countries.

Science in its highest aspects has always been, as at the present time, the property of the whole world, knowing no political restraint or nationality. The barrier of language, however, has had much to do with retarding the diffusion of knowledge from the original sources of discovery into the text books, which serve as the means of enlightenment for the mass of learners.

The great discoverers and thinkers in our present subject, since the days of Malpighi, an Italian, have been either French, German or English. The Germans, before 1865, made no discoveries of commanding importance, and even their text books barely gave a true account of the subject as known at the time. Link, in 1807, ignored the all-important discoveries of Senebier and De Saussure, the more readily, doubtless, because they were Frenchmen. Twenty-five years afterward De Candolle's general treatise was translated from the French and became one of the most influential text books in Germany.

The chief activity among Englishmen occurred before 1800, and brought forward the names of Hales, Priestley and Ingenhousz. The advanced work was taken up by Frenchmen after 1800, among whom Senebier, De Saussure, Dutrochet and Boussingault are the most conspicuous investigators.

It is chiefly the French botanists, particularly De Candolle and Dutrochet, who have had the most potent and lasting influence upon the popular conceptions of the English regarding vegetable physiology. To them we can also trace a number of errors and omissions which figure in our school text books at the present time. De Candolle was the author of the imaginary "spongioles" upon the root tips, which still have a sort of backwoods existence in the minds of some persons, although practically eradicated from the text books. He subscribed to the dual respiration of plants by which they gave off oxygen in daylight and carbon dioxide in darkness, which is still taught by certain American text books. In other American text books, which are still standard, a reaction is shown by the suppression of any suitable account of respiration proper, this important subject being referred to only incidentally in a line or two in connection with a short account of the use plants make of stored food material. Thus, in the latest revised edition of Gray's Lessons in Botany, as in the preceding edition, barely three lines are devoted to respiration, while two pages are given to assimilation. This work also teaches the incorrect doctrine[3] that carbon dioxide beside reaching the plant through the surface of the leaves, "is absorbed by the roots of plants, either as dissolved in the water they imbibe, or in the form of gas in the interstices of the soil." In Bessey's Botany, first issued in 1880, respiration is treated in essentially the same brief manner, and it is curious to note that the unusually complete index to the work does not contain the words gas, breathing, or respiration.

The modern phase of plant physiology may be said to have been introduced to English speaking students by the translation of Sach's text book in 1875, and reinforced by the appearance of Goodale's work in 1885, on this side of the Atlantic, and of Vines' work the following year in England. In these works the balance between respiration, assimilation and the physical movement of gases is fairly well maintained. Another work in English, less pretentious, but equally accurate and discriminating with the last mentioned, and antedating them, should be spoken of here, that of Johnson's How Crops Feed, published in 1870. The work was deservedly popular, and is still a source of exact information.

---

[3] In the discussion which followed the reading of this paper, Prof. Geo. L. Goodale gave Dr. Gray's reasons for retaining his early views. It was Dr. Gray's belief that his statement would prove, upon more extended investigations, to be essentially correct. Prof. W. H. Brewer spoke in further support of the conservative views of Dr. Gray.

(*To be continued.*)

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

BY CLARENCE B. MOORE.

(*Continued from November Number, 1892.*)

(*Second Paper.*)

SHELL HEAP THREE MILES NORTH OF PALATKA.[1]

This shell heap on the west bank of the St. John's has been largely washed away by the river, and in addition great quantities of its shells have been "lightered" to Palatka for use upon the streets. It was visited by Wyman and by Le Baron[2] who probably made no excavations, or at all events, did not put them on record. Implements found by them both at this point can be seen at the Peabody Museum, Cambridge.

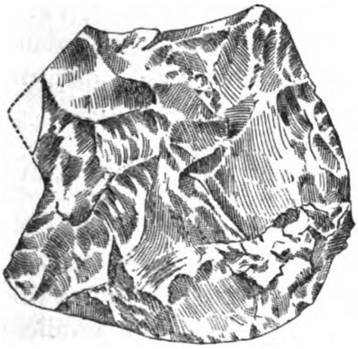
This shell heap is peculiarly rich in relics of stone and of bone, the implements and arrow-heads being rough and of the shell heap type, a much ruder form than the arrow-head or chisel usually found on the surface throughout Florida. It was twice visited by the writer, who found nothing of interest through excavation, but who, in April, 1892, was fortunate enough to be upon the ground at a period when the river was lower than upon any previous occasion on record, leaving bare a large area usually covered by water and rich in relics washed from the section of the shell heap bordering upon the river. A careful search yielded six bone awls; four other implements of bone; two articular portions of the bone of the deer, separated from the shaft by the aid of a cutting instrument; one flat fragment of bone lined along the entire length, with a hole in the center extending almost through; a small piece of greenstone cut into the form of a pyramid, and six arrowheads, one of quite unusual pattern for the St. John's River, though found in some of the Western States[4] (Fig. 1).

---

[1] W. W. Calkins (Proceedings of the Davenport Academy of Natural Sciences, Vol. 2, pages 226–227) explored a river mound "north of Palatka," which may be identical with the one under consideration.

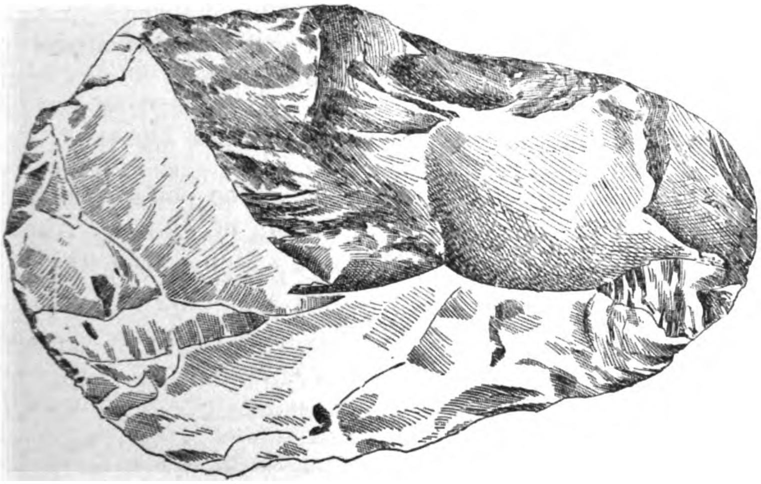
[2] Smithsonian Report, 1882, p. 771 et seq.

FIG. 1. Size, ½.



Captain Rossignol, formerly in charge of lighters carrying shell to Palatka, presented the writer with a collection of implements found *in situ*, at this place, by him, comprising a number of rude arrow-heads and an implement of chert very

FIG. 2. Size, ½.



---

[4] Charles C. Jones, Jr., in "Antiquities of the Southern Indians," describes implements of this character as being broken arrow-heads turned into scrapers. Fig. II, Plate xiv, represents a specimen from Georgia.

roughly wrought on one side, the other being left flat and smooth, recalling the implements of the Moustier Cavern, Dordogne, France (Fig. 2). This shell heap is probably one of the earlier class. A careful search along the entire section of the heap exposed to the action of the river failed to reveal any pottery, and none was met with in digging. Two pieces upon the surface were probably from later Indians. Investigations at this spot, however, were not based upon enough excavations to give a final judgment upon the subject.

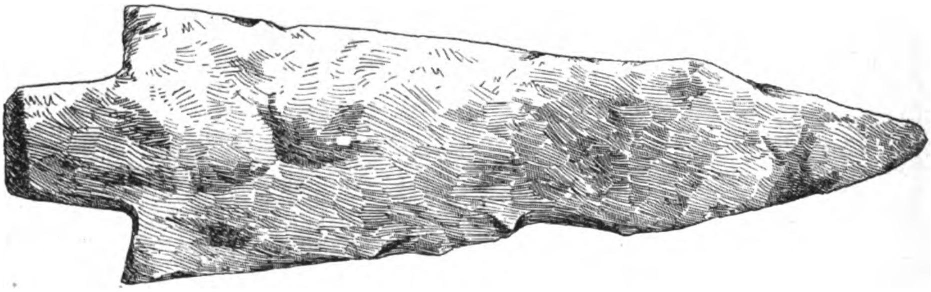
TWO SHELL HEAPS ON SALT RUN.

Salt Run makes into Lake George about two miles southwest of where the St. John's leaves the lake. On the right bank, going up, at a distance of about half a mile from the mouth, is a shell deposit some two hunderd yards in length and one hundred yards in breadth, with a height of from four to five feet on the water's edge, increasing to a maximum of ten feet somewhat beyond the middle toward the land. On the same side of Salt Run, about half a mile farther up, is a deposit of shell presenting no irregularities of surface, though varying in depth at different points, owing to unevenness of ground upon which the deposit was made.

EXCAVATION I.

5½x5x3½ feet deep; after surface loam no pottery was met with. Fragment of bone awl at a depth of 3½ feet. About three feet down was found, within half a foot of the bottom of

FIG. 3. Size, $\frac{1}{1}$.



the shell deposit, a lance-head of graceful pattern, perfect in every respect; the only lance-head, as far as the writer has been able to learn, ever found at a considerable depth from the surface in any of the shell heaps of the St. John's (Fig. 3). Other excavations yielded nothing of marked interest.

HITCHEN'S CREEK.

At the point where the St. John's River enters Lake George is Volusia Bar. About half a mile south, Hitchen's Creek joins the St. John's on the east side of the river. A short distance above, on the left hand side, going up the creek, are shell heaps and fields under cultivation; in all, about seven acres. A number of excavations yielded the usual bones of edible animals, and showed traces of numerous fire-places at varying depths. In the rear of the dwelling the shell deposit, considerably higher than elsewhere, is closely packed, the shells being crushed to a marked extent and having a large admixture of sandy loam—a "kjökkenmödding." In this deposit, below two feet, no pottery was met with, and the Paludinæ were of small size, in comparison to those of some of the shell heaps. Scattered on the surface were *Paludinæ georgianæ* of large size, mingled with a Paludina previously unknown, *Paludina georgiana*, variety *altior*, Pilsbry.[5] The portion of the shell deposit, toward the swamp, is composed of unbroken shells, mostly of the two varieties of Paludina, of unusually large size and unmixed with sand or loam. Plain pottery is found in great abundance throughout. Water is reached at a depth of two feet. This deposit was probably made by the aborigines living upon the shell ridge adjacent, after the ridge had attained considerable size, since but few of the new variety of Paludina were found in the ridge below the surface and at comparatively little depth.

SWAMP SHELL RIDGE NEAR MORRISON'S CREEK.

About three miles south of Volusia Bar, Morrison's Creek, a "cut-off," divided from the St. John's by an island, enters the river. Below this point, in the swamp, entirely surrounded by water when the river is high, is a ridge of shell running north and south, 350 feet in length, with a maximum breadth of 180 feet. The southern extremity, the lowest portion of the ridge, is from 4½ to 6 feet in height; while the northern end attains a maximum elevation of 11 feet, 10 inches, above the level of the swamp when dry. Two excavations, 8x5 feet, 4 in.x9½ feet deep and 7½x4x6 feet deep, were made. Two or three bits of rude, plain pottery were met with, but none at a greater depth than two feet from the surface. Just below the surface a human humerus was found, and a human vertebra at a depth of one foot. A fire-place was at the same depth but at a distance from the vertebra, which showed no marks of fire. At a depth of four feet was found a triangular implement of shell; while 4 feet, 8 inches, down, immediately upon a fire-place, were two rude arrow-heads, one with ashes upon it. Animal bones, disconnected, mainly of the alligator, the turtle and the deer, were encountered throughout.

---

[5] The Nautilus, April, 1892, p. 142, et seq.

MT. TAYLOR.

This great swamp shell ridge,[6] the highest fresh-water shell deposit on the St. John's River, lies on the east bank, 200 yards (paced) from the water's edge. It is about one mile south of Volusia, and in dry seasons can be reached from the river by wading through the swamp; though access from dry land in the rear, about forty yards distant, is advisable. Under any circumstances, the services of a guide are a necessity. This shell heap is not referred to by Le Baron, nor is it particularly mentioned by Wyman,. who could not have failed to describe so remarkable a heap, had it been accorded a visit. On page 44 of his memoir, Fresh Water Shell Mounds of the St. John's River, Florida, "two mounds, right bank, between Lake Dexter and Volusia," are included in the list of shell heaps. This somewhat indefinite description would seem to indicate that his knowledge of the existence and location of Mt. Taylor was based upon information derived from others and not personally verified.

---

[6] The thanks of the writer are due to Mr. William Edgar Bird, of Brooklyn, for much information and valuable assistance, and for most cordial permission to prosecute investigations on every portion of his 5000 acres lying between Lake Dexter and Volusia; including the great shell heaps and sand mound of Bluffton, in addition to Mt. Taylor and other shell heaps in the swamp.

Mt. Taylor, standing alone in the swamp, which at high water is covered to a depth of 1½ feet. rises abruptly on every side, the ascent of one portion being at an angle of 40°. The maximum height of the ridge is 27 feet, 2 inches; its length at base 500 feet, with a maximum breadth of base of 175 feet. An almost level plateau on the summit has a length of 266 feet, with a maximum breadth of 80 feet. The mound is overgrown with palmettoes, palmetto scrub, live oaks and cedars. It lies longitudinally east and west, and is composed almost exclusively of Paludinæ of a smaller size than those of many of the later shell heaps. With the exception of a few fragments on the surface, no pottery was found in any portion of the heap, while implements of any description were of infrequent occurrence in the various excavations. As a rule, it may be said, the older the shell heap, the fewer relics are met with, though weapons of stone exist at all depths, even in mounds which contain no pottery, and in others below the level at which fragments of pottery are found.

(*To be continued*)

LEGENDS OF THE SUMIRO-ACCADIANS OF CHALDEA.

By Alice Bodington.

In The American Naturalist for August, 1892, Mr. Wilson puts in a strong plea for the study of prehistoric anthropology, nor can the claims of this science be overrated. But of equal interest in its own line is the study of that earliest civilization of Western Asia, which a few years ago was itself prehistoric, and which has only emerged into the light of day since the deciphering of the Cuneiform inscriptions of Assyria and Chaldea.

Some 5000 years B. C., wandering Turanian tribes[1] settled in the fertile alluvial plains at the mouths of the great rivers, Tigris and Euphrates, round the head of the Persian Gulf. Materials for building, it might be thought, did not exist, save for the giant reeds, fourteen to fifteen feet high, with which the Arabs of that marshy region still construct their huts. But the Sumiro-Accadians,[2] as these Turanian tribes were named, had the faculty possessed by their relations, the Chinese, of taking the first steps in inventions. Out of the mud and clay of their new home they made bricks, at first mere cakes of sund-dried clay; then these cakes were found to gain consistency by mixture with finely chopped straw; finally the clay was kiln-dried and gained a hardness and consistency equal to the best bricks produced now. The kiln-dried bricks were highly valued and were stamped with the name and titles of the king for whose palaces and temples they were to be used. Some bearing the name and title of Gudéa, the *patesi* or priest-king of Sirgulla, have inscriptions of a highly archæic character. A statue of unique interest was found at Sirgulla;[3] the head is strikingly Turanian in form and feature and bears a turbaned cap such as may still be seen in Mongolia. No type can be more strikingly unlike that of the Semitic Assyrians who were to be in later times the rulers of Chaldea. This statue, and the bricks with their archæic inscriptions found with it, are considered to be as old as between 4000 and 3000 B. C. A successor to this oldest of known monarchs was Ur-ea, king of Ur, whose date can be approximately arrived at,[4] and whose reign was over before the Elamite Conquest of Chaldea; when Chedorlaomer (Khadar-Lagamar), of Genesis, chapter xiv, marched an army across the desert to attack the rich and populous valleys of Jordan, and carried off Lot, the brother of Abraham, among his captives.

---

[1] Chaldea. Story of the Natives. Z. A. Ragozin.

[2] I must disclaim all responsibility for the spelling of proper names, since every authority I have consulted spells the names differently, and no fixed standard seems to have been arrived at. For instance, the spelling is sometimes Shumiro-Akkadian, sometimes Sumiro-Accadian.

In the materials for holding their bricks together there was also progressive improvement; in the oldest buildings discovered, a sticky red clay or loam was used; then bitumen was substituted, which, being applied hot, adheres so strongly to the bricks that pieces of these are broken off when an attempt is made to take a fragment of the cement. Finally, in the latest Babylonian period, a beautiful white cement made of calcareous earth was used, which has never been surpassed for lightness and strength.

The whole country of Chaldea was absolutely flat; no vestige of natural hillock occurred throughout its whole extent. But the Accadians, whose very name shows their origin as mountaineers, were determined to raise their most important buildings above the inundations, and the wild beasts and noxious insects of the marshy plains. They erected artificial mounds of a size almost incredible. The great mound of Koyun-jik, which represents the palaces of Nineveh[5] itself, covers an area of one hundred acres, and reaches an elevation of ninety-five feet at its highest point. To "heap up such a pile of brick and earth would require the united exertions of 10,000 men for twelve years."[6] Then only could the construction of the palaces begin! The mound of Nebbi-Yuma, which has not yet been excavated covers an area of forty acres and is loftier and steeper than its neighbor. The platform of the principal mound of Mugheir (the "Ur of the Chaldees" from which Abraham went forth) is faced with a wall ten feet thick, of red, kiln-dried bricks cemented with bitumen.

---

[3] Modern Tell-Loh.

[4] Chaldea, p. 214–19.

[5] Though an Assyrian city, Nineveh was built on the Chaldean plan, on a "tell" or mound.

The sub-structure of these mounds was made up of rough bricks and rubbish, hence the inherent weakness of the whole structure. The heavy semi-tropical rains falling for weeks at a time soaked through the casing of fine bricks, and the foundation became a mass of yielding mud. The mighty palaces and temples upon which the Assyrian and Chaldean kings lavished all the resources of wealth, all the treasures of art, sank into sand-choked, shapeless heaps. But the treacherous clay could preserve, hidden from the prowling Arabs who roam over this land of once mighty empires, priceless treasures of art and literature. Exquisite alabaster slabs, richly engraved, beautiful enamelled tiles forming colored friezes; the great human-headed bulls whose very discovery made the name of Layard famous; the life-like groups of lions and lionesses; and incomparably more precious than all, the royal libraries formed by the great kings, have been preserved for centuries beneath these unsightly mounds. For the one available substance, clay, formed the almost imperishable material of which the Chaldean and Assyrian "books" were made.

In the great mound of Koyun-jik (Nineveh) Layard found the remains of two sumptuous palaces, the residences of Sennacherib and of his grandson Asshurbanipal, who lived some 650 years B. C., two of the mightiest sovereigns and conquerors of the Eastern World. In Asshurbanipal's palace the explorer found two small chambers, containing a layer, more than a foot in height, of baked clay tablets, covered on both sides with cuneiform writings. Some were still entire, others in fragments. Layard filled many cases with the tablets, broken and unbroken; they were sent to England, and lay for years in the British Museum untouched and unnoticed. George Smith, a young archeologist whose devotion to science and untiring industry and patience enabled him to undertake —and to succeed in—an apparently impossible task, determined not only to arrange and engrave the cuneiform texts on the tablets, but to *read* them, and this he succeeded in doing. The result was something astonishing. A series of twelve tablets was brought to light containing an epic poem of the highest antiquity and interest, the one alluded to further on, containing the earliest versions of the great Sun, Moon and Earth myths, of the Deluge, of Bel and the Dragon and of the Creation of the world. Fragments, of course, were missing, and to seek these George Smith was sent (by the generosity of the owners of *The London Daily Telegraph*) to search the Archive Chambers at Koyun-jik, and by inconceivable good fortune, found many of the missing pieces. On his second visit to Chaldea he fell a victim to plague. His last legible words were worthy of a martyr to science. "Not so well. If doctor present I should recover, but he has not come; if fatal, farewell to . . . *My work has been entirely for the science I study.* There is a large field for study in my collection. I intended to work it out, but desire now that my antiquities and notes may be thrown open to all students. I have done my duty thoroughly. I do not fear the change, but desire to live for my family."

---

[6] Five Monarchies. Rawlinson, Vol. 1, pp. 317–18.

Besides the tablets containing the epic poem, two hundred tablets divided into three books were found at Nineveh, fifty of which have been deciphered. The contents of these also are supremely interesting; one book, the oldest, reveals the Shamanitic stage of the Sumiro-Accadian religion; a stage in which many Turanian tribes still remain. It treats of "evil spirits" with which earth, sky and the "abyss" under the earth were conceived to be filled; of sorcerers who could employ the power of the evil spirits for the destruction of mankind, and of magicians who understood incantations and spells capable of driving away these malignant powers,[7] answering to the "black" and "white" magic of the Middle

---

[7] La Magie et la Divination chez les Chaldeérs. François Lenormant.

Ages. The second book treats of diseases, for which no cure was known but exorcisms, since diseases were conceived to be personal demons. Even so late as three or four hundred years B. C., Greek travelers visiting Babylon beheld sick persons brought out into the streets, where any passer by could enquire as to their malady and suggest a remedy! Even this strange plan was not resorted to till all known forms of incantation had been gone through and proved vain. The third book shows a great advance from this religion of pure terror. Beneficent spirits, gods in fact, were appealed to, especially Una, the Heaven-god; Ea, the great deity of the Earth and Waters; Im, the Storm Wind; Ud, the Sun, and Gibil, Fire. Ea, above all, was beloved by the Sumiro-Accadians for his goodness and trusted for his wisdom. His very name was a terror to evil spirits. But beneficent as he was, Ea was considered too great a deity to be lightly invoked, and in his son Meridug, they found a spirit whose sole office was to mediate between his father and suffering mankind. A whole tablet is devoted to a description of one such intercession, where the "Disease of the Head (insanity) has issued from the Abyss, from the dwelling of the Lord of the Abyss," and has attacked a human being. Then "Meridug has looked on his misery. He has entered the abode of his father, Ea, and has spoken unto him: 'My father, the Disease of the Head has issued from the Abyss. What he must do against it the man knows not. How shall he find healing?'" Ea replies, "My son, how dost thou not know? What should I teach thee? What I know, thou also knowest. But come hither, my son Meridug . . . ." Here follow directions for the cure of the sufferer that the "Disease of the Head may vanish like a phantom of the night."

The conception of conscience was also carried to a high degree among the Sumiro-Accadians. With such insistence and authority did it speak that it was believed to be the voice of an indwelling guardian spirit. Some most beautiful prayers took their origin from this belief; they have been called the Penitential Psalms, from their striking likeness to those psalms in which King David confesses his iniquities and humbles himself before the Lord. I have space but for a few verses of the Sumiro-Accadian psalm called "The complaint of the repentant heart."

"O my God, my transgressions are very great; very great are my sins. I transgress and know it not. I wander in wrong paths and know it not. The Lord in the wrath of His heart has overwhelmed me with confusion. I lie on the ground and none reaches a hand to me. I cry out and there is none hears me. . . . My God, who knowest the unknown be merciful. . . . How long, O my God? . . . Lord Thou wilt not repulse Thy servant. In the midst of the stormy waters, come to my help, take me by the hand."

Since the key to the cuneiform inscriptions has been discovered, it has been evident that many legends of Genesis are varients of Sumiro-Accadian originals, and that from this source too was drawn the Jewish belief in magic, witchcraft, dreams, supernatural serpents, sacred trees, etc.; whilst the pure Monotheism of later times was fighting hard to establish itself in the hearts and minds of a people, who came from a cradleland of many gods. For in those palmy days of the Yellow Race, when it was at the head of human progress, the Semites are seen as nomad tribes dwelling amongst the Accadians, and in one most noted instance wandering from Ur of the Chaldees, till they finally reached Egypt and the Nile. And the legends, the superstitions, the forms of prayer of Accad are faithfully reflected in the earliest traditions of Israel.

(*To be continued.*)

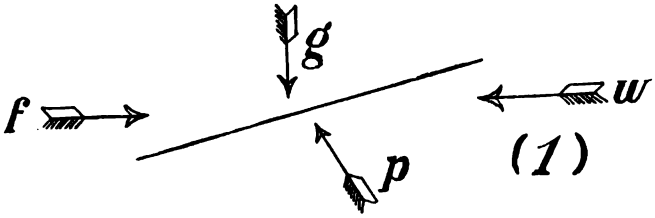
THE FLIGHT OF BIRDS.

By I. Lancaster.

I have been asked what effect the application of soaring methods has upon active wing flight. If soaring goes on so easily where gravity is the motive power, why do not all birds soar?

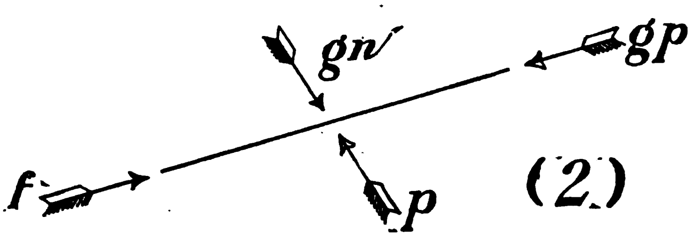
The soaring activity is not understood when such a question is put, obscurity arising, doubtless, from misconception.

The usual statement of soaring held by everybody, and especially by mechanical authority, is diagrammed in 1, where *g* represents weight, *w*, horizontal air resistance, and *p*, normal pressure. When a horizontal force, *f*, is applied, of sufficient magnitude to cause *p* to equal both *g* and *w*, the plane moves on the horizontal path of soaring flight. Soaring, or indeed any sort of bird flight, would be impossible thus stated, which may be called the formula method.

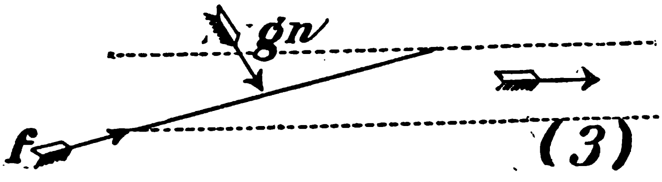


The soaring statement presented by nature, is seen in 2, where the horizontal force, *f*, and the horizontal resistance, *w*, are stricken out. Vertical *g* is replaced by *gn* and *gp*, while *p* remains the same in direction but not in magnitude. The pressure plane of air throws *g* out of vertical, making *gn* and *gp* out of it; *p* is equal to *gn*; *f* is equal to *gp*, and the plane soars; *f* pushes *gp up* as fast as *gn* pushes *p down*, producing a horizontal resultant.

Compare both statements with 3. In either case a prism of air as wide as the distance across the extended wings of the bird, as thick as the perpendicular distance between the front and rear edges of the wings, and say fifty feet long, is driven



out of the way in one second of time. This is done, as above stated, in both cases, but the way of doing it is the vital matter. It is driven out by *gn* and not by *f*. Suppose *f* should stop acting. Motion of bird would then be downward on the normal line, in which motion *gn* would do the same work in one second as before. Motion both ways goes on simultaneously, neither having the slightest effect upon the other, for the reason that they are 90° apart, and rectangular forces do not affect each other, the bird moving under each force as if the other were not acting. The way in which the air is driven out is determined by *f*, but *gn* does all the work. The law of



fluid reactions throws all the air resistance to the bird's motion around, normal to the plane of its wings; *gn* then forces it down, while *f* keeps the bird level.

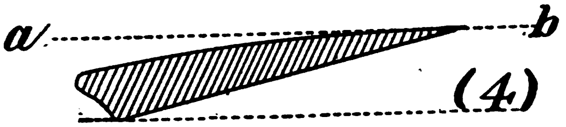
There is yet a very important point to be understood. In methods sanctioned by mechanical authority weight and air resistance are added in pressure. Both are assumed to be resistance to the soaring force. They should be subtracted, not added. *p* is a reaction against *gn* and not a force equal to *gn,* acting with it against the soaring force. Atmosphere resistance to the bird must be overcome, but weight overcomes it, and is itself used up in the exertion.

I once saw a parody on Jack, the Giant Killer. Jack was set upon simultaneously by two giants, either of which could have demolished him at once. He adroitly set them to fighting each other and then cut off their heads. Nature met with much the same problem. She desired a soaring bird. Two antagonists confronted her, air and weight. She so fashioned a bird as to take advantage of the law of fluid pressure, which set weight upon air resistance, in which contest they were both destroyed. She outdid Hercules in details of destruction. Pressure first cut weight into two unequal parts, then fell upon the greater and transformed it into a stream of escaping air condensation, while the smaller still offered resistance. Then from these condensations, equal to the total normal part, she obtained enough force through wing details to destroy the parallel part, and still have a large surplus. And all this was accomplished by a bird's wing. It seems a pity that such a magnificent piece of work should belong only to fishhawks, carrion crows, and the like.

Further, a single matter must be noticed. By referring to 3, it will be seen that there is a region behind and above the lower surface of the bird, and beneath the front edge, of triangular shape, that is not affected by the air. If the bird had but one motion on the upward slant, any thickness of parts, either of wing or body, would resist. But normal motion confines air collision to the under side, leaving a confused mass of eddies and reacting currents at the upper side. This region of eddies may be filled with solid materials and still not destroy the effect of a mathematical plane devoid of thickness. The front edge must be sharp but the rear edge may be overreached, as in 4, without further resistance. Such shape will move farther in the same time unit normally than a flat shape, while parallel motion is not changed in the slightest degree. The least projection above *a b* increases resistance.

I have called this region the "neutral zone," for want of a better name. The bodies of all birds are almost entirely confined to this zone.

The original question is now in order. Why do not all birds soar? For many reasons, among which are the following:



1. A bird may be of such shape that to throw it over to an inclination that gives a parallel factor small enough to be neutralized by the forward thrust would get part of the animal out of the neutral zone. The gray pelican of the Gulf coasts is a case in point; especially when its gullet is full of fish. It must flap to get thrust for its large parallel factor. If its wings were one foot longer on each side, it could doubtless soar continuously, even if its body did encroach on resisting air to some extent.
2. Weight may be too great for surface. In this case condensations escape too readily to be utilized. A wild turkey, prairie-chicken, or pheasant, are examples.
3. Weight may be too little for surface. Here condensation is too weak to give thrust. A species of sea-gull found on the lower Florida peninsula is a good example. In May and June, when food is scarce, they flap continually. In November and December, when food is plenty, they rarely move a wing. They will put into an empty craw their weight in food.
4. Life habits may prevent suitable feather construction. I presume this reason may apply to many small birds.

In the case of bats, the small factor may be entirely neutralized by flapping, as there seems to be at least no surface provision for utilizing the escaping condensations.

Flying squirrels do not sustain themselves.

But in no case of bird flight that I am acquainted with, can it be said that the normal factor is opposed by flapping. That is cancelled by its own work on air. Flapping goes on for the sole purpose of producing parallel motion by either increasing the energy of the condensations, or by a backward push against the air.

It must be borne in mind that the nearer the bird's wings approach horizontal, the less will be the obstructive gravity factor, but on the other hand, the more contracted will be the neutral zone. The moment this zone is encroached upon, more is lost in resistance of air, than is gained by lessening the small factor.

In experimenting, I never pay the least attention to what I have called the "soaring force," meaning thereby the force required to push the plane to the resultant, after the small factor is neutralized. I have never used scales delicate enough to measure this force. The moment the small factor is out of the way, the plane runs to the front to the limit of its freedom.

There is the narrowest possible margin between active and fixed wing flight. The only group of white pelicans I ever met with, eight in number, moved through the air in alternate flapping and gliding motion. Once only, I found them facing a southwester on fixed wings. They rested in the gale as firmly as if fastened to a rigid support. I had been observing them daily for five months and was rewarded by this very unusual exhibition. I shot one of them and found its gullet and intestines full of fish, and it could only spread one square foot of surface to each five pounds of weight, the greatest contrast of surface to weight I ever found.

The entire subject of bird flight has been persistently misconceived. It must be recast in toto to rescue it from the mass of delusion that involves it. To speak of erroneous details is labor lost. It is *all* erroneous. There is no stress in the entire activity, either in direction or magnitude, where stresses are supposed to be. When it is seen that from eleven-twelfths to seventeen-eighteenths, approximately, of total weight is employed in overcoming total air resistance to the bird's motion, it is easily conceivable that the animal may overcome the remaining resistance without the necessity of estimating the muscular exertion of a creature weighing eight ounces in terms of horse power.

EDITORIALS.

EDITORS, E. D. COPE, AND J. S. KINGSLEY.

—At the October meeting of the American Humane Association, held in Philadelphia, a resolution was passed of a very dangerous nature. It urged upon the Legislature of every State in the Union the enactment of laws which shall prohibit, under severe penalty, the repetition of painful experiments upon animals for the purpose of teaching or demonstrating well-known and accepted facts. The danger lies not in the intent, but in the fact that incompetent persons will feel it their duty to say that this experiment is painful, that another is unnecessary; and further, it strikes a deadly blow at all future increase of knowledge. An investigator in physiology can only be trained by the laboratory method. He cannot read the accounts of previous work and, with no further preparation, proceed at once to the solution of new problems. He must, rather, test his powers of experimentation by this very repetition which the proposed law prohibits. He must demonstrate for himself "well-known and accepted facts," and until he is able to bring his results into full accord with those facts he is incompetent to enter untrodden fields where he is without checks upon the accuracy of his results.

That the proposed legislation is not so vicious as some, which, fortunately, has been rare in the United States, is a matter for which we should be thankful; but, on the other hand, it would place a dangerous tool in the hands of such fanatics and unqualified persons as commonly occupy important positions in connection with the societies for the prevention of cruelty to animals. The writer has a somewhat extensive acquaintance with the physiological investigators of both Europe and America, and he knows them to be as a class humane persons unwilling to inflict unnecessary suffering upon any animal, and at the same time fully as competent to judge of the necessity of any experiment as the persons whom the proposed legislation would put in the position of prosecutors and judges.

—Lieutenant Peary has obtained leave of absence from the Secretary of the Navy for the purpose of further prosecution of Arctic explorations. He proposes to establish himself at a point on the northern coast of Greenland already visited by him as a base for explorations northward. He expects to travel over the ice which covers the ocean, toward, and if circumstances permit, to the pole. It will be a fortunate circumstance, and one conducive to the success of the expedition, if land shall be found to the north of Greenland. This, Lieutenant Peary suspects, may be the fact. Transportation will be thus more easy and less dangerous, and much of interest to science may be expected to result. The determination of the geologic and paleontologic features of the region is of first-class importance to world-history, and much important evidence will be contributed toward the solution of some at present obscure problems.

—THE numbers of THE AMERICAN NATURALIST for 1892 were issued at the following dates: January, March 26; February, March 31; March, April 25; April, April 29; May, May 1; and all subsequent numbers on the first of the month named on the cover and pages.

RECENT BOOKS AND PAMPHLETS.

Allen, J. A.—On *Colaptes auratus* and *C. cafer.* Ext. Proceeds. Am. Mus. Nat. Hist., 1892. From the author.

Bailey, L. H.—The Horticulturalist's Rule-Book, completed to the beginning of the year 1892. From the author.

Banks, N.—The Spider Fauna of the Upper Cayuga Lake Basin. Ext. Proceeds. Acad. Nat. Sci. Phila., 1892. From the author.

Baur, G.—Ein Besuch der Galapagos Inseln. München, 1892. From the author.

Bean, T. H.—Description of a new species of Star-gazer (*Cathetostoma albigutta*) from the Gulf of Mexico. Ext. Proceeds. Natl. Mus., Vol. xv. From the author.

Bulletins No. 16 and 18 Agri. Exp. Station of the Rhode Island College of Agriculture and Mechanic Arts.

Bulletin No. 18 Iowa Agri. Exp. Station. From Herbert Osborn.

Bulletin No. 43 Mass. State Agri. Exp. Station, Aug., 1892.

Claypole, E. W.—Traces of the Ice Age in the Flora of the Cuyahoga Valley. Tract No. 84 Western Reserve Hist. Soc. From the author.

Dall, W. H.—Tertiary Mollusks of Florida, Part 2. Trans. Wagner Inst. Science. From the author.

——Instructions for Collecting Mollusks and other Useful Hints for the Conchologist. Part G of Bull. U. S. Natl. Mus. No. 39. From the Smithsonian Institution.

Day, D. T.—Mineral Resources of the United States. Washington, 1892. From the author.

Dollo, L.—Sur le *Lepidodteus suessoniensis.*——Sur la Morphologie de la Colonne vertébrale.

——Sur la Morphologie des Côtes. Exts.du Tome xxiv, Bull. Sci. de la France et de la Belgique.

——Nouvelle Note sur le Champsosaure, Rhynchocephalien adapté à la vie fluviatile. Ext. Bull. Soc. Belge de Geol., Paleont., et Hydrol. Bruxelles, Tome v, 1891. From the author.

Dumble, E. T.—Third Annual Report of the Geological Survey of Texas for 1891. Austin, 1892.

——Notes on the Geology of the Valley of the Middle Rio Grande. Ext. Bull. Geol. Soc. Am., Vol. iii, pp. 216–230. From the Society.

Dyar, H. G.—Descriptions of Some Butterfly Larvæ from Yosemite. Ext. Can. Entomol., Oct., 1891. From the author.

Evolution in Science, Philosophy, and Art. Popular Lectures and Discourses Before the Brooklyn Ethical Association. New York, 1891. From D. Appleton & Co., Publishers.

Gaertner, F.—Concerning the Differentiation of Black Pigment in the Liver, Spleen, and Kidneys, from Coal-dust Deposits. Reprint Microscope, July, 1889. From the author.

——Vivisection. Ext. Am. Nat., Oct., 1891. From the author.

Gill, Th.—Notes on the Tetraodontoidea. Ext. Proceeds. Natl. Mus., Vol. xiv. From the author.

Graff, L. von.—Bibliothek des Professors der Zoologie und Vergl. Anatomie. Leipzig, 1892. From the author.

Habets, M.—Extrait du rapport sur l'Industrie des Sardages à l'Exposition Universelle de 1889. From the author.

Harle, E.—Une Mandibule de Singe du Repaire de Hyenes de Montsaunes. Ext. Compte-rendu fév., 1892. From the author.

Hay, O. P.—On the Breeding Habits, Eggs, and Young of Certain Snakes.

—On the Ejection of Blood from the Eyes of Horned Toads. Exts. Proceeds. U. S. Natl. Mus., Vol. xv. From the Smithsonian Institution.

Hayes, C. W.—An Expedition Through the Yukon District. Ext. Natl. Geog. Mag., Vol. iv, pp. 117–162. From the author.

Herndon, J. H.—Plea for the Life of the Geological Survey of Texas.—— Review of the charges preferred against Prof. E. T. Dumble, State Geologist, for "Incompetency, Plagiarism, and Maladministration in Office," and the sham trial thereof. Austin, 1891. From the author.

Hitchcock, R.—The Ancient Pit-Dwellers of Yezo, Japan. Ext. Reprint Natl. Mus., 1890, pp. 417–427.

—Descriptions of Two New Forms of *Basileuterus rufiforms* from Mexico. Ext. Proceeds. Natl. Mus., Vol. xv. From the author.

Ideals of Life. A Symposium on the Coming Man. Edited by Wallace Wood, M. D. New York, 1892. From E. B. Treat, Publisher.

Jordan, D. S.—Evolution. Syllabus of Lectures. Alameda, 1892. From the author.

Kedzie, J. H.—Speculations. Solar Heat, Gravitation, Sun Spots. Chicago, 1891. From the author.

Kirby, W. F.—Elementary Text-book of Entomology, Second Edition. London and New York, 1892. From Macmillan & Co., Publishers.

Lerch, O.—A Preliminary Report on the Hills of Louisiana, North of the Vicksburg, Shreveport and Pacific Railroad. From the author.

Marcou, J.—The Geological Map of the United States and the United States Geological Survey. Cambridge, 1892.

Mason, O. T.—The Ulu, or Woman's Knife, of the Eskimo. Ext. Rept. Natl. Mus. for 1890. From the Museum.

Merrill, G. P.—Handbook for the Department of Geology in the U. S. National Museum. Ext. Rep. Natl. Mus. for 1890. From the Museum.

Osborn, Herbert.—Lice Affecting Domestic Animals. Ext. Bull. No. 16, Iowa Agri. Exp. Station.

Report of the Commissioner of Fish and Fisheries Respecting the Establishment of Fish Cultural Stations in the Rocky Mountain Region and Gulf States. Washington, 1892.

Report of the Conduct of the British Museum for 1891. London, 1892.

Ridgway, R.—The Humming-Birds. Ext. Rep. Natl. Mus., 1890, pp. 253–383. From the Smithsonian Institution.

Riley, C. V.—Directions for Collecting and Preserving Insects. Part F of Bull. U. S. Natl. Mus., No. 39. From the Smithsonian Institution.

Rust, Dr. D.—Contributions to Canadian Micro-Paleontology, Part 4, with an introduction by J. B. Tyrrell. Ottawa, 1892. From the Can. Geol. and Nat. Hist. Survey.

Science Teaching in the Schools. Report of the Committee of the American Society of Naturalists, 1891.

SHUFELDT, R. W.—The Myology of the Raven. A Guide to the Study of the Muscular System in Birds. London and New York, 1890. From Macmillan & Co., Publishers.

STEJNEGER, L.—Two Additions to the Japanese Avifauna, including Description of a New Species. Ext. Proceeds. U. S. Natl. Mus., Vol. xv, pp. 371–373. From the Smithsonian Institution.

TARR, R. S.—A Hint with Respect to the Origin of Terraces in Glaciated Regions. Ext. Am. Jour. Science, Vol. xliv, 1892.

——Reconnaissance of the Guadalupe Mountains. Bull. No. 3, Dept. Agri., Insur. Statis. and Hist. Geol. Survey Texas, 1892.

——The Relation of Secular Decay of Rocks to the Formation of Sediments. Ext. Am. Geol., July, 1892. From the author.

TOWNSEND, C. H. T.—Notes on North American Tachinidæ *sens str.* with descriptions of New Genera and Species. Ext. Canadian Entomologist, March, 1892.

——A Parasite of the Fall Web-Worm.——A New Simulium from Southern New Mexico.——Description of a Sarcophaga Bred from Helix.——Exts. Pryche, 1892.

——A Tachinid Parasite of *Crysophanus dione*. *Exorista chrysophani* n. sp.——Description of a Muscid Bred from Swine Dung, with Notes on Two Muscid Genera. Exts. Entomol. News, 1891.

——Notes on North American Tachinidæ with Descriptions of New Genera and Species. Ibid, 1892. From the author.

WHITE, I. C.—The Mannington Oil Field and the History of Its Development.

——Fossil Plants from the Permian Beds of Texas. Exts. Bull. Geol. Soc. Am., Vol. iii, pp. 187–218. From the Society.

RECENT LITERATURE.

The Apodidæ.[1]—This, one of the latest of the "Nature Series," is not up to its predecessors either in accuracy of statement or suggestiveness of matter. The author, starting off with the intention of working up the comparative anatomy of this family of phyllopod crustacea, has been led to regard them as all-important in phylogenetic speculations, but, unfortunately, the good points of his volume are not original, while the original portions cannot be praised. Thus the central position of the Phyllopods in the Crustacean branch was recognized long ago, while the comparison of the foot of the Apus with the parapodum of a Polychæte worm was made long before Bernard entered the field of zoology. On the other hand the special studies of Mr. Bernard have led him to regard the differences between the annelids and Apus as of extremely minor importance. All you have to do, says he in effect, is to bend the anterior end of a carnivorous annelid back upon itself to produce this portion of Apus, and the thing is done. Resemblances are magnified and differences are minimized or ignored, and presto! Apus is the all-important arthropod. The name of Macmillan & Co. is so uniformly associated with only first-class works that we were surprised to see it on the present volume.

Darwin, and After Darwin; I, The Darwinian Theory, by George John Romanes.[2]—Romanes has devoted the best years of his life to the defence of the evolutionary faith and to making himself acquainted with, advocating, and extending Darwin's ideas. The present work consists of two volumes, viz., "The Darwinian Theory," and "Post-Darwinian Questions." The latter, soon to be issued, is to treat of heredity, utility, isolation, etc., which have become prominent since the death of Darwin. The former is a systematic exposition of the Darwinism of Darwin. It gives a résumé of the evidence, as it is known at present from classification, Morphology, Embryology, Paleontology, and Geographical Distribution, and includes a full discussion of the Theories of Natural and of Sexual Selection. It is a neat volume of 460 pages, fully illustrated with new figures that largely increase its value. It is the best single volume on the general subject that has appeared since Darwin's time, and it is doubtless destined to be for years to come the one book to which general readers will turn for a concise statement of his ideas.

---

[1] The Apodidæ. A morphological study, by Henry Meyners Bernard. London and New York. Macmillan & Co., 1892.

[2] Chicago. The Open Court Publishing Company, 1892.

The principle of continuity makes antecedently probable the theory of organic evolution. The probability is strengthened by the fact that a natural classification of organic beings seems with the advance of knowledge more and more evident. The evidence from Morphology in the present volume is confined largely to a discussion of rudimentary structures, and especially such as are found in the human body. Muscles of the external ear, panniculus carnosus, feet, hands, tail, vermiform appendix of the cæcum, ear, hair, teeth, perforation of the humerus and flattening of the tibia are all treated. In this connection Dr. Louis Robinson's recent interesting observations on the grasping power of the infant's hand are reported. In discussing Embryology, considerable space is devoted to the phenomena of fertilization and karyokinesis, since the author believes the great similarity in these highly complex and specialized processes, shown throughout the animal and vegetable kingdoms, to be indicative of organic continuity, and hence evidence of the highest importance. The testimony afforded by connecting links, which has accumulated mainly since Darwin first published, forms an interesting section, made more interesting by good figures. Geographical Distribution is mainly a summary of Wallace's observations.

The evidence for and against the theory of Natural Selection is fully and fairly given. Romanes believes this principle to be not the sole, but the most important, factor of organic evolution. The main general arguments in favor of the theory are three, viz., its inherent necessity, the facts of heredity, variation, and struggle for existence being excepted; the fact that among all the millions of structures and instincts, each is developed for the benefit of its own species, and in not a single case for the exclusive benefit of another species; also the facts of domestication. Protective coloring, warning coloring and mimicry afford strong evidence. The theory of Natural Selection is often misunderstood, even by its advocates, notably by Wallace. Certain apparently strong objections to it are capable of being answered, and this Romanes proceeds to do, discussing the presence of similar organs in widely different groups (Mivart's instance of the eyes of the cuttlefish and of vertebrates), and the preservation of the first beginnings of structures (the Duke of Argyll's "Prophetic Germs"), where the principle of correlation must play so important a part. The electric organ in the tail of the skate is a formidable case, which our present knowledge is not able satisfactorily to dispose of. In the last chapter Mr. Wallace's objections to Darwin's theory of Sexual Selection are replied to. The relations of the Darwinian doctrine to adaptation and beauty in organic nature are discussed in brief, and finally its relations to the fundamentals of religion.—F. S. Lee.

The Diseases of Personality, by Th. Ribot.[3]—The new Psychology is under a great debt to Ribot for his studies of nervous diseases. In this last volume he bases personality as the highest form of psychic individuality upon the organic sense. All the bodily organs are constantly sending into the central nervous system impulses that give rise to sensations. These organic sensations are relatively more prominent in the lower animals, because there they are not, as they are higher in the scale, covered up by desires, passions, perceptions and ideas. Everywhere, however, they form the physical basis of personality. The author analyzes the organic, emotional and intellectual conditions and disorders of personality. The discussions include the meaning of "individual" in various forms of animal life; the personality of twins and double monsters; the rôle of memory; transformations brought about by hallucinations and by ideas; the phenomena of the dissolution of personality in cases of progressive dementia. A convenient, if not entirely comprehensive, classification of the diseases mentioned is that its three categories, viz., *alienation* (where the changed person is either entirely ignorant of his former self or regards it objectively), *alternation* (ordinary cases of double consciousness), and *substitution* (where the individual takes on a new character, yet is conscious of his former one, as where he now believes himself a king, although he remembers that he was formerly a poor man).

It is to be hoped that the same publishers will issue in the same neat form the author's works on the diseases of memory and of the will.

F. S. Lee.

---

[3] Authorized translation, Chicago. The Open Court Publishing Co. pp. 157.

General Notes.

GEOLOGY AND PALEONTOLOGY.

On the Formation of Oolite.—Dr. A. Rothpletz has proposed a theory of the formation of oölite, which is as interesting as it is novel. He noticed on the shores of Great Salt Lake, Utah, snow-white and silver-gray calcareous corpuscles in great numbers. They form a large part of the beach sand, and where they lie in the water they are partly covered with a bluish-green alga-mass. On examination the algoid bodies proved to be colonies of cells of the lime secreting algæ, Glœocapsa and Glœothece. By a series of experiments Dr. Rothpletz satisfied himself that the calcareous bodies secreted by the plants and the calcareous bodies which compose the beach sand are identical. Pursuing his researches, the author investigated the oölites from the strand of the Red Sea, and found that although slightly differing in structure, these oölites originate similarly to those of Salt Lake; that is, from lime secreting algæ.

In studying fossil forms Dr. Rothpletz has found in a gray limestone from the Lias of the Vilser Alps, and in the great oölite structure of the Wettersteinkalk structures analogous to the calcareous bodies from Salt Lake. Also the structure of certain calcareous oölites investigated by Wethered, and more recently by Bleicher (May, 1892), closely resembles that of the Red Sea oölite. In view of these facts, Dr. Rothpletz is inclined to believe that at least the majority of the marine calcareous oölites with regular zonal and radial structures are of plant origin; the product of microscopically small algæ of very low rank, capable of secreting lime.—From *Botanisches Centralblatt.* Translated by F. W. Cragin for the *American Geologist*, Nov., 1892.

Geology of Northeastern Alabama.[4]—Mr. Hayes' report covers the topography, drainage, stratigraphy and structure of Northeastern Alabama and adjacent portions of Georgia and Tennessee. It is intended as a basis for the economic geology of that region, and is, therefore, general rather than special and detailed. The rocks of the area under consideration are all Paleozoic, and include representatives of all the larger subdivisions of that system. A columnar section of the strata exposed east of Browntown Valley gives the Cambrian rocks an average thickness of 7550 feet; the Silurian, 5935 feet; the Devonian, 180 feet; and the Carboniferous, 2175 feet. The formation names are all new, being purely geographic and local. It is questionable if the making of new names is necessary in regions contiguous to those with similar formations whose names have been generally adopted. The reason advanced, "to avoid all remote correlations," does not seem sufficient to warrant such innovations.

---

[4] Report on Geology of Northeastern Alabama and adjacent portions of Georgia and Tennessee. Bulletin No. 4, Geological Survey of Alabama. By C. Willard Hayes, Assistant Geologist U. S. Geol. Surv., 1892.

The report is accompanied by an excellent Geological map which shows a structure section through Northeastern Alabama.

The Mesosauria of South Africa.—Paleontologists are indebted to Prof. H. G. Seeley for a detailed description of the Mesosauria of South Africa, and an exact statement of the relations of Mesosaurus with Stereosternum.

For many years the genus Mesosaurus has been evidenced by a single fossil from Griqualand, South Africa, described by Gervais in 1865 under the name *Mesosaurus tenuidens*. In 1878 four specimens from the shale at the margin of the Kimberley Diamond field were obtained by Mr. G. H. Lee, and deposited in the British Museum. They show that Mesosaurus was a long-tailed reptile, with hind limbs well developed. Mr. Seeley found it impossible to refer the Kimberley specimens to *M. tenuidens*, and described them under the name *M. pleurogaster*. The well-developed abdominal ribs, formed of flattened plates, give this species its most distinctive feature.

A second specimen of *M. tenuidens* found in the district of Albania by David Arnold, preserved in the Cape Town Museum, shows the ventral aspect of the anterior part of the skeleton. There are some differences between this specimen and the type, but Mr. Seeley does not consider them important enough to prove specific distinction.

Another specimen of the same genus, from near Burghersdorf, is in the Albany Museum at Grahamstown. It shows the dorsal aspect of dorsal vertebræ and ribs. It indicates a new species, but there is no character available for its definition except that of relatively stout ribs.

In discussing the relations of Mesosaurus with Stereosternum, Mr. Seeley refers to *Stereosternum tumidum* from Brazil, described by Cope in 1886, and figures the shoulder girdle of that species to show a pair of wide, thin, crescentic bones in advance of the shoulder girdle. In regard to these bones Mr. Seeley says: "If the transverse expansion seen in the Paris type of ***Mesosaurus*** is the same bone, its form is imperfect, but it is in the same position as the lateral crescentic bone of *Stereosternum*. There is nothing in the Cape Town ***Mesosaurus*** which corresponds in form with these bones in *Stereosternum*, and the shoulder girdle in the two types seems to be unlike, because the coracoids in the Brazilian genus met (as shown by the thickened margin) in the median line, while in ***Mesosaurus*** there seems to have been a squamous overlap as in Monotreme mammals, and as the coracoid cartilages overlap in *Triton* and *Salamandra*. This condition, so far as I am aware, is not otherwise suggested by remains of fossil reptiles. There is also a possible resemblance to Salamanders in the fact that the scapula and coracoid are not separable, though the Cape Town ***Mesosaurus*** appears to indicate a suture.

These African Sauromorpha closely resemble some genera from the Trias of Europe in general form and characters of the humerus. This leads Mr. Seeley to present, for the present, the following classification of a small group to which he gives the name "Mesosauria:"

MESOSAURIA.

General Characters.—Palate closed in the median line, teeth slender, prehensile; cervical ribs with a single articulation, dorsal ribs articulated to the anterior face of the neural arch. The shoulder-girdle formed of scapular and clavicular arches. Humerus expanded distally with an ent-epicondylar foramen. Digits terminating in claws.

Division I. Proganosauria.

Articular faces of centrum conically cupped, coracoid and scapula anchylosed, a larg clavicle (or separate episcapulæ), a sacrum of four vertebræ, a foramen in the pubis, five bones in the distal row of the tarsus, neck short, tail long. South Africa, South America.

Division II. Neusticosauria.

Articular faces of centrum flat, coracoid and scapula separate, clavicles relatively small (no separate episcapula), sacrum unknown, a notch instead of a foramen in the pubis, neck long, tail short. Europe.

This order is an important diagnostic type of its horizon, and all additional knowledge respecting it is welcome.

Quarterly Jour. Geol. Soc., Nov., 1892.

Kansas Pterodactyls.—The wealth of material in the museum of the Kansas University affords Prof. Williston the opportunity to compare the genera Nyctodactylus, Pterodactylus and Pteranodon, with the following result:

"It seems very probable that the genus Nyctodactylus has no teeth in its jaws; it agrees in *every other respect* with the genus Pterodactylus, so far as known. Now, in not a few species of Pterodactylus the teeth are confined to the anterior end of the jaws, and their entire absence, unaccompanied by other structural differences, will hardly constitute an order, or even a family.

"Pteranodon differs from Pterodactylus, so far as that genus is known, in the united coracoscapulæ and pubes, both of which characters are found in Rhamphorhynchus.

"The sole family characters remaining then, for Pteranodon, are absence of teeth, a supra-occipital crest, and the articulation of the upper end of the scapula."

Prof. Williston, therefore, proposes the following classification:

Order Pterosauria.
Family Pterodactylidæ; sub-families, Pteranodontinæ, Pterodactylinæ.
Family Rhamphorhynchidæ.
Family Ornithocheiridæ.—Kansas University Quarterly, July, 1892.

Geological News, General.—Prof. S. W. Williston considers the practice of American text-books in Geology in introducing generic names of characteristic fossils as the names of the geological horizons whence they come as very reprehensible. Leconte's Elements contains a long list of such names that have long been out of use by paleontologists.—Kansas Univ. Quart., July, 1892.——According to T. Mellard Reade, marine sands are rounded and highly polished, while non-marine but purely glacial sands are invariably angular.—*Geological Magazine*, Oct., 1892.——M. Boule calls attention to some well-preserved remains of *Elephas meridionalis* found in the volcanic terranes of Senèze (Haute-Loire). They resemble *E. meridionalis* of the English Crag. This fossil confirms M. Boule's previous statement that while some of the volcanoes of the valley of the Allier (Coupet and Chilhas) were active during the middle Pliocene, others, like Senèze, are contemporary with *E. meridionalis*, and are therefore more recent.—*Revue Scientifique*, Nov., 1892.

Paleozoic.—A new form of the rare group Agelacrinitidæ has been found in the lower carboniferous limestone of Cumberland, England. The fossil is described and figured in the Quart. Jour. Geol. Soc. May, 1892, under the name *Lepidodiscus milleri*, by G. Sharman and E. T. Newton.——Mr. H. G. Seeley describes a new reptile from Welte Vreden, Cape Colony, *Eunotosaurus africanus*. The dorsal vertebræ in form and number suggest the Chelonian type, but the specimen affords no proof that the whole of the dorsal vertebræ are preserved. Every character preserved differs from those of South African fossils hitherto known, with the exception of the pubis, which suggests that the specimen is referable to the Mesosauria in a division distinct from the Proganosauria.—Quart. Jour. Geol. Soc., Nov., 1892.——Eleven new species of Lower Silurian Ostracoda referable to the two genera Leperditia and Schmidtella are described and figured by E. O. Ulrich in the Amer. Geol., Nov., 1892.

Mesozoic.—Mr. Arthur Hollick calls attention to some fossil molluscs found at Tottenville and Arrochar, Long Island. Prof. Whitman has determined them to be marine cretaceous species. These, in connection with cretaceous plants found in the same locality, establishes the cretaceous strata which have hitherto been assumed to extend along the southern and western shores of Long Island.—Trans. New York Acad. Sci., 1892, p. 96.——A new Mosasaur, *Clidastes westii*, is described by Mr. Williston. The fossil was found in the uppermost of the Niobrara beds, and consists of a complete lower jaw, quadrate, portions of the skull, the larger part of the vertebral column, and the incomplete hind and fore paddle. It is estimated that the animal in life measured seventeen and one-half feet.—Kansas Univ. Quart., July, 1892.——Mr. Uhler's observations show three structural units in the Tuscaloosa formation instead of the one insisted upon by McGee and Darton. His division is as follows: 1 The Potomac formation proper laid down on the broken border of the crystalline rocks and capped by the variegated clay. 2 The Albirupean formation, which includes the series of clays, sands and cobble-stone deposits resting between the variegated clay and the base of the Severn formation. 3 Alternate clay sands resting upon the irregular and eroded surface of the white clay or sand of the preceding group.—Trans. Maryland Acad. Sci., 1892.

Cenozoic.—The collection of fossil marsupials at Queensland includes a fine series of mandibles of *Phascolomys mitchellii*, which support Mr. De Vis in making this a distinct species from *P. platyrhinus*. —Proceeds. Linn. Soc. N. S. W., 1891.——Two species, *Laganum* *decagonale* and *Cassidulus florescens*, have been added by Mr. Gregory to the Australian fossil Echinoidea. The papers recently published by Cotteau, Tate, Bittner, and Gregory on Australian Cenozoic Echinoids, show that the fauna in question is Eocene and Oligocene instead of Miocene, and that it is remarkably rich and varied in genera.—*Geol. Mag.*, Oct., 1892.——A collection of mammalian bones from Mongolia reported on by Lydekker are of interest since they carry the Chinese mammalian fauna to a more northern district than has hitherto been known, and they indicate two Indian Siwalik species not previously recorded from Chinese territory, viz., *Hyæna macrostoma* and *Equus sivalensis*.—Records Geol. Surv. India, Vol. xxiv.

MINERALOGY AND PETROGRAPHY.[1]

The Origin and Classification of Igneous Rocks.—Mr, Iddings[2] has recently published at length the data upon which are based his conclusions concerning the causes of the different structures exhibited by the igneous rocks of Electric Peak and Sepulchre Mountain and of their varied mineral composition. The main results reached by this study have already been noticed in these pages.[3] It may be well again to call attention to the fact that in this region the different conditions attending the final consolidation of the ejected and of the intruded magmas affected not only their crystalline structure, but also their essential mineral composition; consequently, the molecules in a chemically homogenous fluid magma combine in various ways and form quite different associations of silicate minerals, producing mineralogically different rocks. For instance, biotite is an essential constituent of even the most basic of the intrusive rocks, while in the effusive phases it is rarely found in rocks containing less than 61% of SiO_2. Again, quartz is common in the coarser grained varieties of the former and is absent from those of the latter. Therefore, it is more proper to consider intrusive and effusive rocks that have a like chemical composition as *corresponding* or *equivalent* rocks, than those forms of the two series that have similar mineral compositions. The classification of igneous rocks should recognize the close dependence of structure and mineralogical composition upon geological relations. But, since the structure is the best exponent of these relations, structure should form the basis of this classification. Though giving most of his attention to the general subject of the relation existing between the structure and the geological position of the rocks of the area described, the author devotes a portion of his article to illustrating the intergrowths of hypersthene, pyroxene and hornblende that occur so plentifully developed in the rocks of the region.——In a second paper the same author[4] attacks the great problem of the origin of igneous rocks. He introduces the subject by outlining the growth of the theory first enunciated by Scrope, that the varieties of igneous rocks are the result of the differentiation of a homogeneous magma. Scrope's notion was a crude one, but it has been built upon little by little until it has, in the hands of Mr. Iddings, been placed upon a footing secure enough to warrant its being thoroughly tested by observation and experimentation. The author points out the evidences of the close relationships exhibited by the rocks emanating from a volcanic center and their differences from similar groups from other centers, and then takes up the question of the differentiation of molten magmas. He brings forward geological and chemical evidences of the fact of differentiation, and explains the act upon Soret's principle that in a solution whose parts are at different temperatures there will be a concentration of the salt in the colder parts. Lagorio has shown that rock magmas are solutions, and Iddings believes they are solutions of the chemical elements or of their oxides. Consequently, after differentiation has taken place and cooling sets in, different minerals are formed according to laws that depend upon the proportions of the oxides occurring in the differentiated portions. This is apparently contradictory to the view of Rosenbusch,[5] who regards rocks as having originated in the differentiation of a magma, but of a magma which is a solution of *silicate salts* in a *silicate solvent*. As a result of the condition of affairs suggested by Iddings the first eruption from a volcanic center would naturally possess a composition intermediate between those of succeeding eruptions. As a fact the author states that the sequence is usually a rock of intermediate composition, followed by less siliceous and more siliceous ones, to those very basic and very acid. The last eruptions are of very exceptional character. These will occur in small quantity only, and will be first eroded from the surface. Consequently these forms will be found principally in dykes. They are the forms to which Rosenbusch has given the group name "Ganggesteine." These rocks, according to Iddings, have their equivalents among volcanic flows, but the association of minerals in them is different. It is simply their structure, therefore, that characterizes the dyke rocks. They have originated in the same manner as have other eruptives, and consequently are not essentially different from them. The author's views are developed carefully and at considerable length. They will undoubtedly serve to turn the attention of petrographers to a subject that has lain neglected long enough—the comparative study of rocks of single geological provinces. The paper will well repay very careful reading by all petrographers and theoretical geologists, who should be glad to know that it is on sale by the Philosophical Society of Washington, from whose secretary it may be purchased for $1.

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Twelfth Ann. Rep. Director U. S. Geol. Survey, Washington, 1892, p. 569.

[3] Cf. AMERICAN NATURALIST, April, 1890, p. 360.

[4] The Origin of Igneous Rocks. Bull. Philos. Soc. Wash., xii, 1892, p. 89.

---

[5] AMERICAN NATURALIST, Nov., 1890, p. 1071.

The Novaculites of Arkansas.—In his excellent discussion of the novaculites of Arkansas, Griswold[6] describes most of these rocks as consisting of very tiny irregular grains of quartz with occasional specks of carbonaceous matter. Originally the rock contained also well crystallized rhombohedra of calcite, traces of which are sometimes seen in the sections. Generally, however, the calcite has entirely disappeared, and its place is now occupied by a rhombic cavity, around which the quartz grains are packed as though they had been shoved about by the crystallizing carbonate. The good cutting qualities of Arkansas whetstones are thought to be due to the presence of these cavities. The purity of the Hot Springs novaculite is shown by an analysis that yielded:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss	Total
99.45	.26		.12	tr.	.19	.54	.06=	100.62

According to the author the rocks were first deposited as a mud or ooze, in which calcite crystallized. They were then consolidated by simple pressure, and finally, after upturning and erosion, they were supplied with a small quantity of secondary silica.

Petrographical News.—Osann[7] has discovered that the mineral heretofore regarded as sodalite in the Montreal eleolite-syenite is nosean, as it contains 5-6% of SO_4, and very little calcium. It is quite abundant in the rock, and is included as idiomorphic grains in its garnets. A microscopical test proposed by the author for distinguishing between nosean and sodalite is as follows: Moisten slide with dilute acetic acid to which a little barium-chloride has been added, and allow to stand in an atmosphere of the acid. Sodalite remains transparent, while nosean is covered with an opaque coating of barium sulphate.

The coloring matter of the black limestone of the Pyrenees is shown by Jannetaz[8] to be carbon, probably in the form of anthracite.

The new catalogue of geology and petrography issued by Ward's Natural Science Establishment, of Rochester, N. Y., deserves mention

[6] Ann. Rep. Geol. Survey of Ark. for 1890, Vol. iii, pp. 122–168.

[7] Neues Jahrb. f. Min., etc., 1892, i, p. 222.

[8] Bull. Soc. Franç d. Min., xv, 1892, p. 101.

in these notes because of the full list of rock names contained in it. The principal rock types are defined, and under each are given the technical names of all its varieties. It is further interesting as an indication of the growing importance of lithology in this country, since it is quite evident that Prof. Ward would not find it advisable to keep in stock such a large quantity of rock material were the demands for it rare. The catalogue may well serve the geologist as a table of petrographical synonyms.

A New Occurrence of Ptilolite.—A new occurrence of *ptilolite* has been discovered by Cross and Eakins[9] in Custer County, Col., about three miles southeast of Silver Creek, in the vesicles of a dull green devitrified pitchstone. The mineral is in very slender needles that are optically negative. An analysis made on very carefully *selected* material gave:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O	Total
67.83	11.44	3.30	.64	2.63	13.44=	99.28,

which is equivalent to $R_7\,Al_2\,Si_{10}\,O_{24}+6\frac{2}{3}\,H_2O$, a formula identical with that determined for mordenite by Pirsson.[10] Clarke[11] regards a part of the water in each mineral as basic, and believes that mordenite, the ptilolite from Silver Creek and the original ptilolite (which is poor in Na_2O) are mixtures of the salts. $Al_2\,(Si_2O_5)_5\,Ca\,H_2.\,3Aq$, $Al_2\,(Si_2O_5)_5\,Ca\,H_2.\,6Aq$, $Al_2\,(Si_2O_5)_5\,Na_2\,H_2.\,6Aq$ and $Al_2\,(Si_2O_5)_5\,K_2\,H_2.\,6Aq$.

Mineralogical News.—*Polybasite* and *tennantite* are reported by Penfield and Pearce[12] from the Mollie Gibson Mine in Aspen, Col. The former is the ore of the mine. It occurs massive, often associated with barite and siderite. It is of a grayish-black color, and has disseminated through it patches of the lighter tennantite. Analyses, corrected for impurities, follow:

	S	As	Sb	Aq	Pb	Cu	Zn	Fe
Polybasite.....	18.13	7.01	.30	56.90		14.85	2.81	
Tennantite...	25.04	17.18	.13	13.65	.86	35.72	6.90	.42

Crystals of both minerals are known to occur in several of the Colorado mines, though they have not yet been described.

[9] Amer. Jour. Sci., August, 1892, p. 96.

[10] Cf. AMERICAN NATURALIST, 1891, p. 372.

[11] Amer. Jour. Sci., August, 1892, p. 101.

[12] Amer. Jour. Sci., July, 1892, p. 15.

The *cerussite* from Pacaudière, near Roanne, Loire, France, is stated by Gonnard[13] to be associated with copper, silver and lead compounds, pyrite, limonite, quartz and calcite. Its simple crystals present a large variety of planes. Twinned crystals are common, and trillings are known. A description of the several types is given by the author. For sixty years past the same mineral has been known to occur at the argentiferous galena mines of Pontgibaud Puy-de-Dôme, but the fact has not been noted in the treatises on Systematic Mineralogy. All the crystals seem to have been formed at the expense of galena and bournonite by the action of CO_2 from the neighboring volcanic vents. The habit of its crystals is well described by Gonnard[14].

Morenosite [(Ni Mg) SO_4+7H_2O] in green stalactites from the foot of the Breithorn in Zermatt, yielded the same mineralogist[15] the figures $SO_3 = 28.7$; $NiO = 18.5$; $MgO = 6.5$; $H_2O = 46.5$. A single fragment of an ochre-yellow mineral from New Caledonia is a silicate of nickel, magnesium and iron:

SiO_2	Fe_2O_3	Al_2O_3	NiO	MgO	H_2O	Total
33.0	18.5	1.5	26.3	8.0	14.0 =	101.3

Frossard[16] substantiates the statement of Mallard that the black garnet *pyreneite* is a grossularite and not a melanite as reported by Raymond. Its density varies between 3.375 and 3.53.

Vesuvianite is reported by Pisani[17] from Settino in the Rhetian Alps. Its analysis gave:

SiO_2	Al_2O_3	FeO	CaO	MgO	MnO	Loss	Total
39.0	14.3	1.8	37.4	6.7	tr.	.9 =	100.1

The supposed *martite* crystals in the rock of Cuzeau, Mont Doré, are tabular hematites cemented into octahedra by magnesio-ferrite, as determined by Lacroix.[18]

In the basic clays of Condorcet near Nyons, Drôme, France, are boulders of siliceous limestone, with cavities whose walls are lined with bi-pyramidal *quartz* crystals, transparent *celestite*, *dolomite* and *calcite*. The quartz and celestite both contain rare planes beautifully developed.[19]

---

[13] Bull. Soc. Franç d. Min., xv, 1892, p. 35.
[14] Ib., xv, p. 41.
[15] Ib., xv, p. —.
[16] Ib., xv, p. 58.
[17] Ib., xv, p. 47.
[18] Ib., xv, p. 11.
[19] Ib., xv, p. 27.

Mineral Syntheses.—Bourgeois and Traube[20] having failed to produce *carbonates of the magnesium* group of elements by the reaction of urea, water and metallic chlorides on each other at 130° in sealed tubes, have made another attempt at their synthesis by substituting potassium cyanate for the urea. The attempt proved successful, needles of *aragonite* and rhombohedra of *dolomite* and *magnesite* having been produced under the conditions mentioned, when the chloride used was a mixture of the magnesium and calcium salts in molecular proportions.

By the slow action of dilute solutions of copper chloride upon freshly precipitated lead hydroxide at ordinary temperatures there is produced a blue powder consisting of octahedra and cubes of *percylite*, with which are associated quadruple twins of a colorless mineral supposed by C. Friedel[21] to be *phosgenite.*

Crocoite has been obtained by Ludeking[22] upon allowing a strong solution of caustic potash to stand for some time in contact with lead chromate in the presence of a little potassium chromate. By using a large excess of very strong caustic potash *phœnicochroite forms.* The crystallization of the latter substance is due to the abstraction of the solvent by the carbon-dioxide of the air, and of the former by a further reaction between the caustic potash and chromic acid.

New Minerals.—*Penfieldite.*—This mineral, discovered by Prof. Genth[23] on the slags from Laurion, Greece, is evidently produced by the action of sea water upon the materials of the slag. It is usually in the form of hexagonal prisms with basal planes, or in prisms tapered by pyramids. The color is white and the lustre vitreous to greasy. An analysis of the tapering crystals gave: $Cl = 18.55$, $Pb = 78.25$, $O =$ ——, indicating the formula $Pb\,O.\,2Pb\,Cl_2$.

Brazilite is a new tantalo-niobate from the iron mine Jacupiranga, in S. São Paulo, Brazil. Hussak[24] describes it as occurring in the magnetite-pyroxene rock called by Derby jacupirangite. It was separated by washing the decomposed residue of this rock in a miner's pan, and has heretofore been taken for orthite. Its crystallization is monoclinic with $a : b : c = .9859 : 1 : .5109$. $\beta = 98°\ 45\frac{1}{2}'$. The forms observed in its crystals are $\infty P\overline{\infty}$, ∞P, $\infty P2'$, $-P\overline{\infty}$, oP, $P\overline{\infty}$,

---

[20] Ib., xv, 1892, p. 13.

[21] Ib., xv, 1892, p. 96.

[22] Amer. Jour. Sci., July, 1892, p. 57.

[23] Amer. Jour. Sci., 1892, p.

[24] Neues. Jahrb. f. Min., etc., 1892, ii, p. 141.

$2P\infty'$, P and —P. The crystals are tabular parallel to the orthopinacoid and are nearly always twinned, frequently yielding very complicated groupings. The color of the larger crystals varies from sulphur-yellow to black. Their hardness is 6.5 and density 5.006. The plane of their optical axes is parallel to the clinopinacoid, and the double refraction is negative. The extinction is 8°–15° in obtuse β, and the pleochroism varies between dark-brown and oil-green. The minerals associated with brazilite are apatite, magnetite, perofskite, ilmenite, and a spinel. An analysis of the new minerals is promised shortly.

Landauer's Blowpipe Analysis.—This little book[25] will be cordially welcomed by English and American teachers in colleges in which the use of a large manual of blowpipe analysis is undesirable. It is as suitable for classes in mineralogy as in chemistry, since it will enable the student to determine the composition of a mineral as rapidly as will the use of the great majority of Determinative Mineralogies upon the market. Moreover, it possesses one desirable advantage over those schemes in which the hardness, color and streak of chemical compounds are made to serve as distinctive tests for them, in that it compels the experimenter to study the chemical nature of the substance with which he is working. A mineral is a definite chemical substance. A student of mineralogy who is unfamiliar with the composition of bodies with which he is working, though he may know considerable about their physical properties, is neglecting the foundation upon which his knowledge of minerals must rest. The little book before us is an excellent introduction to the larger works like those of Brush and Plattner. It is, besides, complete enough for most of the purposes to which such a book is usually put. Beginning with a good description of the apparatus and reagents necessary to blowpipe manipulation, it follows with an account of the operations employed, describes Bunsens flame reactions, mentions the distinctive tests for the various chemical elements, gives Landauer's and Egleston's schemes for the systematic examination of inorganic substances, and closes with tables exhibiting the reactions of the various metallic oxides, and in a condensed form the results of the different operations described in the text. The book must find a place in many laboratories.

[25] Blowpipe Analysis, by J. Landauer. Authorized English Edition by James Taylor. Second Edition. Macmillan & Co., 1892, pp. 14 and 173.

BOTANY.

A New Edition of Wolle's Desmids.—Botanists who failed to secure a copy of the first edition of Wolle's "Desmids of the United States," and who were meditating whether or not to pay the extortionate prices charged by the antiquarian booksellers, will be glad to know that the author has brought out a new edition with considerable additions, which he is offering at $6.50. The book was well worthy of this new edition, which will doubtless find a ready sale.

Botanical Definitions.—It is the misfortune of every science that it has a mass of technical words or of words with technical meanings, which must be defined before they can be understood by the general reader. Indeed the number of these terms is so great in some sciences, notably Botany, that even the professional botanist is obliged to turn to some handy volume for the meaning of a strange word. So we must have glossaries and dictionaries of scientific terms. The latest one to appear is Crozier's "Dictionary of Botanical Terms," a pretty volume of about 200 pages, upon which the publishers (Holt & Co.) have done well their share of the work. Turning to the substance of the volume we find it disappointing. While it catalogues about 6000 words and omits few words of importance, and while its definitions are generally not false, they are in very many cases so meagre as to leave the user of the book little wiser after than before consultation. The author has failed to distinguish between a true statement regarding a word, and a *definition* of the word. Many of the definitions in this book do not define. As examples, see Accessory Gonidia ("gonidial formations in some species of Mucorini in addition to the typical kind"), Apical Cell ("the generating cell of a growing point"), Archegonium ("the female organ in the higher cryptogams"), Basidiospore ("a spore borne on a basidium, as those of mushrooms"), Linnæan System ("the system of classification devised by Linnæus, founded upon the number and arrangement of the stamens and pistils; sexual system"), Sexual System ("see Linnæan system"). On the other hand, some of the definitions of the new terms are well drawn. The older terms fare pretty well, and are as well defined as they usually are. It is the new terms which often fare badly. Yet such a book is not wholly useless. When one needs to confirm his impression as to the meaning of a word it will be helpful, for, as indicated above, the statements are generally true. The general reader, however, and the beginner in botany who meets a word for the first time and who seeks a definition which will give him a clear notion of its meaning, will often turn away disappointed.—CHARLES E. BESSEY.

Timely Words as to the Nomenclature Question.—At this time, when there is not a little of ferment and effervescence over the rules which should govern in the nomenclature of plants, it will be well for us all to read the following remarks made by Alph. De Candolle in the introduction to the "Paris Code" of 1867. They convey very well the ideas of the "moderns" of to-day.

"The system of nomenclature of organized beings, founded by Linnæus, was looked upon until the middle of this century as extremely ingenious, and has been thought, by some authors, a most admirable one. It was quoted in philosophical lectures and found superior to that of chemical nomenclature, on account of its adapting itself more readily to changes necessitated by the progress of discovery. Botanists professed for it the greatest veneration. They boasted of having developed a better nomenclature than zoologists, which is not surprising, as the most illustrious botanists, thirty or forty years ago, gave infinitely more attention to this subject than zoologists.

Nevertheless, of late years, a change has been perceptible; opinion is wavering, enthusiasm abated. Here and there, in different countries, doubts have arisen and complaints have been made regarding the system of botanical nomenclature." * * *

"It follows that it is useful—every twenty years, for instance—to revise the *ensemble* of received rules." * * *

"Without going far back it is easy to see that since the end of the eighteenth century botanists have endeavored to free themselves from many useless shackles put on by Linnæus and tightened by his disciples, above all with relation to the choice of generic names. De Candolle [the elder, in *Théorie Elémentaire*] was ruled by the idea of having the law of priority properly respected, a law which, fifty years ago, was often unscrupulously infringed." * * *

"The time must however come, when actually existing vegetable forms having all been described, herbaria containing undoubted types of them, botanists having made, unmade, or oftentimes remade, elevated or lowered, and above all modified, some hundred thousand groups, from orders downward to simple varieties of species, the number of synonyms having become infinitely greater than that of admitted groups—it will become necessary to effect some great revolution in the formation of science. This nomenclature that we are striving to improve will have the appearance of an old scaffolding, made up of parts laboriously renewed one by one, and surrounded by a heap of more or less embarrassing rubbish, arising from the accumulation of pieces successively rejected. The edifice of Science will have been constructed, but it will not be sufficiently clear of all that has served to raise it. Perhaps there will then come to light something very different from the Linnæan nomenclature—something will have been devised for giving definite names to definite groups." * * *

"In the meanwhile, let us improve the system of binomial nomenclature introduced by Linnæus. Let us endeavor to accommodate it to the continued and necessary alterations that take place in science, and for this purpose let us diffuse as well as we can the principles of the method; let us attack slight abuses, slight negligence, and let us come, if possible, to an understanding on debated points. We shall thus have prepared, for some years to come, the way for better carrying out works on systematic botany."

Engler and Prantl's "Naturlichen Pflanzenfamilien."— This great work is making such headway that another year will nearly complete it. During 1893 we are promised the Fungi, Hepaticæ, Musci and the Pteridophytes. The Gymnosperms and Monocotylodons, are already completed, while but few families of the Dicotylodons remain to be worked. Recent numbers treat of the Compositæ (74), Oleaceæ, Salvadoraceæ and Loganiaceæ (75), and Myxogasters and Fungi (76), the last by the well-known Mycologist Schröter. His tabular view of the system of classification of the Fungi which he adopts is instructive. See page 50.

- Phycomycetes.
  - Oömycetes.
    - Sporangieæ
      - Hemisporangieæ: *Chytridineæ.* *Ancylistineæ.*
      - Eusporangieæ: *Monoblepharidineæ.* *Saprolegnineæ.*
    - Conidieæ: *Cystopodineæ.* *Peronosporineæ.*
  - Zygomycetes.
    - Sporangieæ: *Mucorineæ.*
    - Conidieæ: *Entomophthorineæ.*
- Eumycetes.
  - Ascomycetes.
    - Hemiasceæ: *Protomycetineæ.* *Ascoidineæ.*
    - Euasceæ.
      - Protoasceæ: *Saccharomycetineæ.* *Endomycetineæ.*
      - Holoasceæ.
        - Hymenioasceæ.
          - Gymnocarpeæ: *Taphrineæ.* *Helvellineæ.*
          - Hemikleistocarpeæ: *Pezizineæ.* *Phacidiineæ.*
          - Kleistocarpeæ: *Tuberineæ.*
        - Plectasceæ: *Gymnoascineæ.* *Elaphomycetineæ.*
        - Pyrenoasceæ: *Perisporiineæ.* *Sphaeriineæ.* *Hysteriineæ.*
  - Basidiomycetes.
    - Hemibasidieæ: *Ustilagineæ.* *Tilletiineæ.*
    - Eubasidieæ.
      - Protobasidieæ.
        - Phragmobasidieæ: *Uredineæ.* *Auricularineæ.*
        - Schizobasidieæ: *Tremellineæ.* *Dacryomycetineæ.*
      - Holobasidieæ.
        - Hymeniobasidieæ.
          - Gymnocarpeæ: *Exobosidiineæ.* *Thelephorineæ.* *Clavariineæ.* *Hydneineæ.* *Polyporineæ.*
          - Hemiangiocarpeæ: *Boletineæ.* *Agaricineæ.* *Phallineæ.*
          - Angiocarpeæ: *Hymenogastrineæ.* *Lycoperdineæ.* *Nidulariineæ.*
        - Plectobasidieæ: *Sclerodermineæ.*

ZOOLOGY.

Locomotion of Limpets.—Herdman records[1] several facts which seem to militate against the view that limpets do leave their resting place and return to it again. It has been shown that they can leave and travel some distance, but he found a specimen of *Patella vulgata* which was sticking to a cylindrical bar of iron and which had the shell molded to fit the surface. Now as the bar was short and free to move about, the probabilities are that if it once left the support it would never be able to return to it. In other cases he found limpets at the bottom of deep pits, from which it would be very difficult, if possible at all, for them to extricate themselves.

Tunicate Studies.—Herdman publishes[2] some notes on the structure of the Appendicularian, Œkopleura. This form was studied by serial sections, and the results, most interesting, are: The condition of the endostyle as a diverticulum to a great extent shut off from the branchial sac; the presence of a genital duct; the distribution of the enlarged ectoderm cells and the cuticular test; the exact course of the nerve cord through the posterior part of the body; and the shapes and positions of the alimentary and reproductive viscera.

In the same publication[3] Garstang points out that *Appendicularia mossii* (*Mossia dolioides*) is to be regarded as a member of the genus Kowalevskia of Fol, and that it in reality has not that importance from the phylogenetic standpoint which was attributed to it by Herdman in his "Challenger" report.

The Skeleton and Teeth of the Australian Dugong.—Zoologists are indebted to Prof. G. B. Howes and Mr. J. Harrison for a valuable paper on the skeleton and teeth of the Australian Dugong, of which the following is an abstract:

"The authors showed that the vertebral epiphyses are more fully developed than Albrecht has suspected, and that they appear late and rapidly ankylose with the centra, a feature of especial interest, in view of Lefévre's alleged discovery of fully developed epiphyses in *Halitherium schinzii* and *Metaxytherium*. On comparison with the Cetacea they sought to associate the reduction of the epiphyses with adaptation to an aquatic existence.

---

[1] Trans. Liverpool Biol. Soc., vi, 22, 1892.

[2] Trans. Liverpool Biol. Soc., vi, 40, 1892.

[3] L. C., p. 57, 1892.

"In dealing with the limb-skeleton they described a longitudinal cleavage of the phalanges, akin to that recorded by Kükenthal for the Cetacea. The only structures observed which were at all comparable to supernumerary phalanges were derivations of the terminal (ungual) ones, arising proximally; and the observations lend no support to Kükenthal's view that supernumerary phalanges are epiphysial in origin.

"The first upper incisor and the four lower ones of either side were shown to have milk predecessors, which are early absorbed. Five teeth were shown to be present on either side of the symphysial region of each mandibular ramus of *Manatus*, the fifth one being claimed as a canine; and in this animal the authors described milk predecessors to the two anterior pairs of mandibular cheek teeth."

On the Cephalo-humeral Muscle and the So-Called Clavicle of Carnivora.—At a meeting of the Philadelphia Academy, Dr. Harrison Allen spoke of the peculiarities of the cephalo-humeral muscle in mammals and invited especial attention to the presence of a small fibro-cartilaginous disc in the junction of the cephalo-humeral with the muscles which are inserted in the bones at the region of the shoulder. This is well defined in *Felis* and is identified as a rudimental clavicle. Dr. Allen has detected this structure in *Herpestes*, *Taxidea*, *Cercoleptes*, *Bassaris*, and *Procyon*.

The cartilage is either in the form of a flat disc or a minute scythe-shaped rod, and is constant in lying directly over the greatest convexity formed by the round of the shoulder. It seems to give strength to the center of a muscle system of which the cephalic, cervical, pectoral and latissimal sheets are parts. The identification of such a plate or rod with a true clavicle is doubtful, since in *Balantiopteryx* (a genus of bats) the structure above described is remarkably developed, while the clavicle is as well formed as in any other animal. The long rod-like body is continuous with a fascicle of fibres arising from the pectoralis and receives the insertion of the occipito-pollicalis. The anterior end of the rod lies in the upper border of the wing membrane and is continuous with the fibrous thread which represents the tendon of the occipito-pollicalis as this muscle is defined in the bats generally. From both the proximal and distal divisions of this muscle delicate fascicles pass toward the elbow and the entire plan appears to be associated with the rudiment of the characteristic skin sac. Slight modification of this arrangement is met with in the allied genus *Rhynchonycteris*.

Comparison of this arrangement with that seen in the common brown bat (*Adelonycteris fuscus*), the noctula bat (*Noctulinia noctula*), and the false vampire (*Vampyrus spectrum*) showed by the part taken by the rod in *Balantiopteryx* is the tendon of a pectoral muscle-fascicle which is inserted into the occipito-pollical muscle as it crosses the shoulder, while in the group of the Molossi the muscle-fascicle is fleshy throughout its entire extent, but on the whole preserving the same relations. Thus the fibro-cartilage of *Balantiopteryx* is represented by fibrous tissue in *Adelonycteris* and both these in turn by muscle in the Molossi. Dr. Allen believed that it was inexact to speak of a clavicle and of this rod as things which were equal. The clavicle acts with the scapula in supporting the head of the humerus but in no wise limiting or determining its movements, while the rod is always over the outer aspect of the shaft of the humerus below its head and acts as a check to abduction of this bone.—Proceeds. Phila. Acad., Pt. 2, 1892.

A New Synaptomys from New Jersey.—While trapping for a type series of the new race of *Evotomys* described by Mr. Stone in the present number of THE NATURALIST, I had the fortune to secure a specimen of this long-looked-for genus, which is, I believe, the first taken in flesh east of the Alleghany Mountains.

It had previously been detected by the U. S. Department of Agriculture in the rejects of a barn-owl living in the tower of the Smithsonian Institution.

A comparison of the New Jersey specimen with two *Synaptomys cooperii* from Ohio, courteously loaned by Mr. J. A. Allen, of the American Museum of Natural History, N. Y., shows such marked specific differences that it will be unnecessary to more than briefly allude to them.

SYNAPTOMYS STONEI.—Sp. nov. Type No. 567. ad. ♀. coll. S. N. Rhoads, May's Landing, N. J. Dec. 2, 1892.

Special Characters.—Outward appearance and proportions as in *S. cooperii*. Above blackish-brown, with black hairs more predominant over the shorter brown hairs than in *cooperii*. The same color reaching around sides of belly instead of being confined to dorsal area as in *cooperii*. Hoary gray belly and neck of *cooperii* replaced by dark plumbeous gray. Feet, including soles, plumbeous, without brown shade. Two middle toes of fore-feet and four inner toes of hind feet, including nails, white. Tail unicolor plumbeous gray. Lips encircled with narrow white edgings.

Skull narrower, shallower, and, viewed from above, less angular than that of *cooperii*, but of same length. Lower jaws viewed from below, ditto. Incisors shorter, broader, and less cylindrical, with sulcation of upper pair much more distinct. Zygomatic foramen longer and narrower. Sagittal suture and parietals relatively much longer; interparietal transversely narrower, longitudinally longer. Supraoccipital in *cooperii* twice as wide as deep, in *stonei* thrice as wide as deep.

Molars one-third wider and one-eighth longer in *stonei*. In *cooperii* the length of the symphysis mandibuli just equals the distance from its posterior end to the angle formed by the antero-inferior border of the masseteric fossa; in *stonei* the symphysis is one-third longer.

Posterior face of angle of lower jaw in *stonei* very stout, abruptly rounded, and reçurved outward; in *cooperii* it is slender, spatulate, elongated posteriorly in a nearly vertical plane, and the margin below the condyle not thickened as in the former species.

Measurements in millimeters of the New Jersey specimen in the flesh, with averages of six alcoholic specimens of *cooperii*, made by Dr. Coues, are given:

	Full length.	Tail.	Foot.	Ear.
Synaptomys cooperii.........	105	18	18	8
Synaptomys stonei.............	117	18	18	9

The age of specimens on which the above cranial and color characters are based is evidently about the same. In other respects they may be safely considered normal adult representatives of the species in the different localities where they were taken. The new species may fittingly bear the name of my friend and colaborer, Mr. Witmer Stone, Curator of Birds in the Philadelphia Academy of Natural Sciences.

SAMUEL N. RHOADS.

A New Evotomys from Southern New Jersey.—On October 25, 1892, while collecting small mammals near May's Landing, New Jersey, in company with Mr. S. N. Rhoads, I captured a specimen of *Evotomys*, a genus which has not previously been reported from south of Massachusetts and the Adirondacks, except in the higher mountains of North Carolina. The next day three more specimens were secured, and subsequently (December 2) Mr. Rhoads collected four others in the same locality. A comparison of these specimens with a series of *Evotomys gapperii* from Northern New York, which is apparently the most closely related form, shows them to be subspecifically distinct, and I therefore propose for the New Jersey animal the name *Evotomys gapperi rhoadsii* in honor of my friend, Mr. Samuel N. Rhoads.

The comparison of a series of skulls of *E. gapperii* and *E. g. rhoadsii* fails to show any constant differential characters, though the immature specimens of the new race are peculiar in the structure of the last upper molars. In these teeth the first reentrant angle on the inside is opposite the second salient angle on the outside instead of the first reentrant angle as is the case in the adults of both forms. One young specimen of *E. gapperii* shows a tendency to this structure, but in all the other specimens that I have examined the reentrant angles meet, and the outer one is deflected posteriorly.

In proportions the New Jersey race seems to average rather smaller than *E. gapperii* from the Adirondacks, while the tail is shorter and the feet slightly longer than in that species.

As regards coloration *E. g. rhoadsii* is everywhere darker than *E. gapperii*, and has a plumbeous cast on the sides and flanks, while it lacks almost entirely the buff suffusion generally seen on the sides and under surface of the latter species.

Above the color is decidedly darker than in *E. gapperii*, and there are a great many more black hairs scattered over the back. The reddish area is not so well defined and the color is darker—more of a mahogany shade. The tail is distinctly bicolor, but the upper surface is darker than in *E. gapperii*, and the feet have a decidedly gray suffusion, contrasting strongly with the pure white of the latter species.

Some immature specimens of *E. gapperii* approach adult *E. g. rhoadsii* in general coloration, but the young of the latter race with which they should properly be compared have scarcely a trace of the reddish dorsal area, the middle of the back being brownish and the sides gray. The table on next page, will show the comparative measurements of the two forms, the specimens of *E. gapperii* being selected from a series kindly loaned me by Mr. G. S. Miller.

Dr. C. Hart Merriam, of the Department of Agriculture, Washington, D. C., has kindly examined my New Jersey material and compared it with *Evotomys carolinensis* and other species to which I had not access, but its closest relationship appears to be with *E. gapperii.* All the specimens of this new mouse so far secured were taken in a cranberry bog on the Egg Harbor River, about a mile above the town of May's Landing, N. J. The unexpected occurrence of this boreal genus well within the Carolinian Fauna may probably be accounted for by the theory already advanced by Dr. Merriam that in these damp bogs, where the temperature is much lower than in the surrounding dry

Evotomys gapperii.

No.	Sex.	Locality.	Date.	Length.	Tail Vertebræ.	Hind Foot.
$\frac{1570}{1367}$	♂	Peterboro, N. Y.	July 17, 1892	151 mm.	41 mm.	17 mm.
$\frac{1577}{1374}$	♀	" "	July 19, 1892	165	51	18.4
$\frac{1687}{1434}$	♀	" "	Aug. 1, 1892	160	46	19.6
$\frac{1140}{1158}$	♂	Keene Valley, N. Y.	Mar. 17, 1892	155	45	20
		Average..		158	46	19

Evotomys gapperii rhoadsii.

No.	Sex.	Locality.	Date.	Length.	Tail Vertebræ.	Hind Foot.
160	♂	Type, Coll. of W. Stone.	Dec. 2, 1892.	142	40	20
161	♀	" "	" "	130	37	20
570	♀	Coll. of S. N. Rhoads.	" "	123	34	21
571	♂	" "	" "	130	36	20
		Average..		131	37	20

areas, the conditions of life are quite suited to more boreal species, especially animals of nocturnal habits. The presence of various Ericaceous and other boreal types of plant life in these locations also supports this hypothesis.—WITMER STONE, Academy of Natural Sciences, Philadelphia.

Zoological News.—VERTEBRATA.—Some new reptiles and fishes from Australia are described by J. Douglas Ogilby. The list comprises *Typhlops curtus* from the Gulf of Carpentaria, *Hoplocepalus suboccipitalis* from Morel, and *Clupea sprattelloides* from rivers flowing into Port Jackson and Botany Bay. The latter species has until now been supposed to be the young of *C. novæ-hollandiæ*.—Records Austr. Mus., Vol. ii, No. 2.——F. W. True reports that the collection of African mammals presented to the National Museum by Dr. Abbott contains several species apparently new: *Dendrohyrax validus, Mus aquilus, Dendromys nigrifrons, Sciurus undulatus, Cephalophus spadix.* The known range of several species is considerably extended by Dr. Abbott's labors. The mammalian fauna of the Kilima-Njaro region as indicated by this collection includes seventy-one to seventy-three species.—Proceeds. U. S. Natl. Mus., Vol. xv, pp. 445–480.

EMBRYOLOGY.[1]

Gastrulation of Aurelia.[2]—Frank Smith has entered into the controversy between Claus and Goette concerning the origin of the entoblast of Aurelia. The results obtained from his first sections led him to think that the conclusions reached by Goette for *Aurelia aurita* would be confirmed in the case of *A. flavidula.* Better staining, thinner sections and more accurate orientation have, however, made it certain that the gastrulation in this species is much more in accord with the description given by Claus and that the process really is one of invagination. The result of cleavage is a one-layered blastosphere as in *A. aurita.* The cells of the blastosphere are usually somewhat shorter at one pole than elsewhere, and it is from this region that the entoblast is formed. It develops as a single continuous layer of cells surrounding a small cavity, the coelenteron. From the beginning there is a narrow blastopore. Only a small portion of the wall of the blastosphere is concerned in the invagination, and to that extent it is not typical. The cœlenteron is, however, at all stages, an open sac-like cavity, and therefore noticeably different from that of *A. aurita* as described by Claus. The cœlenteron enlarges until the cleavage cavity is entirely obliterated and the entoblast everywhere comes into contact with the ectoblast. The entoblast, at first thin, thickens after the completion of gastrulation.

While the entoblast is formed by invagination, ingression of cells from the wall of the blastosphere into the cleavage cavity does occur, although only in a minority of cases. It may happen any time after the blastosphere contains about 100 cells, sometimes before invagination. When this phenomenon takes place it is similar to that represented by Goette (Figs. 1–5) for the earlier stages of the blastula in *A. aurita*, and consists of the migration into the cleavage cavity of one or two, rarely more than three, of the cells of the blastospheric wall. Soon after invagination the nucleus of the cell disappears and the cell breaks down, or, less frequently, persists until gastrulation is complete. In the latter case it becomes forced through the entoblastic wall into the cavity of the cœlenteron. The cause or purpose of this immigration does not appear.

---

[1] This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2] Bull. Mus. Comp. Zool., Harvard, xxii.

The author thinks that the difference in opinion between Claus and Goette is partially due to there being two kinds of cells that find their way into the cleavage cavity. Besides the large cells just described he found in a much smaller number of cases one or two very small cells that look precisely like the small cells that appear in the deeper part of the ectoblast at about the time gastrulation begins.

There is no evidence that the immigrating cells have anything to do with the formation of the entoblast, and Goette's case is further weakened by the fact that all the conditions shown in his figures (6–9) can easily be reproduced from sections of invaginating gastrulæ of a single stage of development.

Cleavage in Aequoria Forskalea.—Dr. V. Hæcker[3] contributes an interesting series of observations on this subject. He finds that when the specimens are in good condition the time relations between the successive periods of activity are remarkably precise.

If ripe, the eggs are laid between 7 and 7.30 A. M. The first polar body is extruded at 9 A. M. The entrance of the spermatozoan and the division to form the second polar nucleus takes place at 9.30. At 10 A. M. the dyaster stage of the first cleavage nucleus occurs, and with it the first indication of the division of the cell body. The daughter nuclei are undergoing metakinesis at 11, and at 12 the four nuclei of the next set are in the dyaster stage. The nuclear divisions continue to take place an hour apart at least as far as the sixty-four cell stage, and this seems to show that the nucleus is not affected at this period by the amount of cell protoplasm that it controls. Normally nuclear division takes place at the same time throughout the egg, and the blastomeres are of equal size up to the sixty-four-cell stage.

When eggs are laid after the specimen has been kept in an aquarium several days, irregularities generally occur in the time of nuclear division and in the size of the blastomeres. At the same time a pathological form of nuclear division, the triaster, appears, and the mass of cells loses its spherical shape.

A remarkable feature of the cleavage of the egg of Aequoria is the presence of a body for which the author proposes the name *Metanucleolus.* In the older ovarian eggs and in eggs just laid there is a large nucleus containing a very fine network of chromatin and a large spherical or reniform nucleolus. About half an hour after the egg is laid this nucleolus appears to have been extruded, for the nucleus is now much smaller than it was and has no nucleolus, while in the egg outside of the nucleus but close to it there is a body resembling the former nucleolus in every particular, except position. This body, the metanucleolus, never divides, there is never any radial arrangement of the protoplasm about it, and it may be found in one of the blastomeres until a later stage in the cleavage. From a review of the work of Metschnikoff, Boveri, and others, the author thinks that homologous structures have been seen, although wrongly interpreted, in the Leptomedusæ, Anthomedusæ, Siphonophores and apparently also in Mytilus and Sagitta. He has also examined Weismann and Ischikawa's preparations of the winter eggs of Daphnids, with the result that he regards the paracopulation cells as not cells at all, but as in all probability structures homologous with the metanucleoli of the medusæ.

---

[3] Archiv. fur Mikro. Anat., 40 Bd., 2 Heft.

Another point of interest in this paper is the numerical relation between the chromosomes of the second polar spindle and of the first cleavage spindle, there being six in the former and twelve in the latter. Boveri had pointed out that in the forms in which this point had been studied, while the number varied in different species, the number of chromosomes in the cleavage spindle was always just double the number in the last polar spindle, and he had also noticed that the number of the latter in certain species could be arranged in a geometrical series in which the numbers are forms of two (2, 4, 8, 16, 32). Hæcker reviews the literature of the subject and shows that there may be two other series besides this one. There is a series of the forms of three (3, 9, 27, etc.), of which, however, there is but one example, Echinus with nine chromosomes, and then there is a mixed double and triple system (6, 12, 18, 24, 36, 48, etc.), to which Aequoria belongs, as well as the greater part of the insects and the vertebrates. He concludes that all cases so far known may be arranged in three systems in such a way that in general nearly related forms belong to the same system.

R. P. Bigelow.

(1) Zeit. f. Wiss. Zool., 49, 1890, pp. 503–580, plates 24–26.

(2) Zeit. f. Wiss. Zool., 51, 1891, pp. 685–730, plates 35–37.

(3) Zeit. f. Wiss. Zool., 54, 1892, pp. 1–249, plates 1–12.

ENTOMOLOGY.[1]

The Pupa of Argyramœba œdipus Fab.—The description given below is drawn from a pupal skin sent to me with the fly by Prof. C. P. Gillette, who bred the latter from a nest of *Odynerus* sp., at Fort Collins, Colo. In a paper which will be published in *Psyche*, I have described the pupa of *Toxophora virgata* O. S., and also made some mention of the pupæ of Bombyliidæ which have so far been described. The pupa of the present species differs quite markedly in detail from that of the Toxophora above mentioned.

Pupa of *Argyramœba œdipus:* General color of empty pupal skin very pale straw colored; the cephalic horns black, reddish-brown basally, anal horns black, slightly reddish-brown at base; dorsal rows of ridges reddish-brown, the terminal spinous processes blackish; prothoracic spiracles reddish-brown, other spiracles but little darker than rest of integument, slightly brownish. Head conforming to shape of head of adult fly, more or less sub-spherical in form. Eight cephalic horns or teeth arranged in four pairs, the three anterior pairs joined in a common base, the posterior pair removed from others; anterior pair longest, their rufous brown joined basal portion distinctly shorter than their black free terminal portion, moderately slender, nearly straight, directed forward, gradually tapering to tips; second and third pairs more closely approximated one pair to the other than are the first and second pairs, but the two horns of each pair widely removed from each other, both pairs directed nearly forward but at a slightly more downward angle than first pair; third pair much shorter than second, more curved or claw-like; posterior pair closely approximated at base, nearly as large as third pair, but straight and directed inferiorly, situated nearly in middle of ventral surface of head segment; a pair of quite widely separated divergent bristles on outer dorsal surface of anterior cephalic horns; a more approximated nearly parallel pair just posterior to these but arising from integument of head near anterior dorsal edge, being situated just behind the suture at base of cephalic horns; a divergent pair situated just anterior to base of the posterior of fourth pair of cephalic horns; a small bristle on each side at hind margin of ventral surface of cephalic segment. Thorax a little wider than head, the neck being somewhat constricted; a pair of

---

[1] This department is edited by Clarence M. Weed, Hanover, N. H.

closely approximated short bristles arising from the same papilla on lateral dorsal surface of thorax a little anterior to middle; a bristle below these on pleural surface, another still below and a little anterior to this one. Wing cases reaching about to base of third abdominal segment, leg cases a little longer. Scutellar segment about as wide as thorax, with a transverse row of ten or eleven long, more or less curled hairs on each side of dorsum approximated to anterior margin, there being a bare space on median portion of segment between the inner ends of the rows; about ten somewhat longer similar hairs on extreme lateral portion of segment on each side, arranged in a more or less complete semicircle, the open portion of the semicircle being toward the posterior end of body; the lateral hairs are longer and slightly stouter than those of dorsum, being nearly as long as transverse width of segment. Abdominal segments one to four, about same width as scutellar segment, each armed on dorsum with a transverse row of short longitudinal parallel chitinous ridges or very narrow plates, there being thirteen in a row on first and second segments, twelve on third segment, and nine on fourth, the rows a little approximated to posterior margin of segment, especially in middle; these ridges are about two-sevenths as long as length of segment, those in middle of rows being the largest and heaviest, the outer ones shorter and diminishing in size, those on fourth segment less heavy than those of first to third segments, and each ridge is produced at its ends into a spinous or hook-like process, the ridges in profile presenting a crescentic appearance with the concavity uppermost. The other abdominal segments without these rows of ridges, fifth segment nearly as wide as preceding, sixth segment hardly narrower than fifth, the fifth and sixth segments each with a transverse continuous row of hairs on dorsum arising from a transverse ridge, extending down to lateral ventral edge of segment and continued on sides of venter, these rows somewhat approximated to posterior margin of segment. Segments (abdominal) one to four with a thin transverse row of shorter weak hairs on each side of dorsum, arising in posterior edge of rows of ridges, extending down on each side to lateral margin, no hairs on median dorsal portion; same segments with a more or less complete lateral semicircle of longer hairs as on scutellar segment, but somewhat weaker and shorter than those on that segment, the hairs on fourth segment extending beneath on sides of venter. Seventh abdominal segment much narrowed, rapidly and evenly narrowing from base to posterior margin, its width on posterior margin hardly more than one-third its width anteriorly, its mean width about one-half that of sixth segment, with a transverse row of several hairs on each side of dorsum extending below on edge of venter, discontinued in middle on dorsum, slightly approximated to posterior margin of segment. Eighth or anal segment narrow, same width as posterior margin of seventh, nearly as long (to base of horns) as wide, terminated by three pairs of anal horns; anterior or upper pair short, small, situated at base dorsally of middle pair; middle or second pair long, curved slightly upward terminally, nearly as long as length of segment, widened inwardly on basal half so that the bases are closely approximated, inner outline hollowed out on apical portion, longitudinally corrugated at base above, with a dorsal longitudinal groove widening to hollowed portion and then extending narrowly to tip, moderately sharp at tips; third or inferior pair short, small, hardly as large as anterior pair and not so stout at base, directed more downward than middle pair, situated on outer base ventrally of middle pair; just anterior to first pair on dorsum there is a median very small spinous tubercle, apparently a rudiment (or herald) of a fourth pair of anal horns. Prothoracic spiracle situated on lateral front border of thorax (prothorax) just anterior to wing bases, mesothoracic spiracle not apparent, metathoracic spiracle situated anteriorly on lateral edge of dorsum of scutellar segment; first to sixth abdominal pairs of spiracles situated on anterior edge laterally of dorsum of first to sixth abdominal segments; seventh pair situated one on each side of dorsum of seventh segment immediately behind the transverse row of hairs. It is interesting to note that a quite long section of the tracheæ is left attached in most cases to the spiracles on inside of the pupal skin, especially to the thoracic pairs. The fly escaped by the pupal skin splitting along the dorsal median line of the head and thorax, the slit extending slightly into the scutellar segment; also splitting laterally backward on each side of head from a little above the base of anterior cephalic horns along what would nearly correspond to the frontal fissure in Muscidæ, the break curving shortly and obliquely upward to thoracic suture, and allowing the nearly triangular posterior dorsal or upper section of the integument of the head to become loosened laterally below from its junction with the thorax, and hanging like a flap by its median dorsal junction.

Length, 9½ mm.; width of basal abdominal segments, 2½ mm.

The anal extremity of this pupal skin is distended with a dirty colored hardened fluid ventrally, just below and anterior to anal horns, into a large round tubercle with a subcentral deep pit or orifice-like depression which is approximated to posterior margin, the anterior portion of the tubercle being greatly bulged and distended. The diameter of this false tubercle is as great as the posterior width of the sixth abdominal segment. The fluid which distended it is perhaps homologous with the meconium of butterflies.

The description of the manner in which the pupal skin splits to allow the escape of the fly was omitted in the description of the pupa of *Toxophora virgata* in the article above referred to. It is accomplished in the same way as just described for the present species, except that the dorsal median split does not reach posterior margin of thorax, and the dorsal pieces of head are not so much detached from their lateral thoracic fastenings, and are left more quadrangular in shape by the oblique lateral breaks of head. It may also be mentioned that a section of the tracheæ is left attached to inside of prothoracic spiracles.

My reasons for calling the first abdominal segment of other authors the scutellar segment, are stated in the article on Toxophora.

C. H. TYLER TOWNSEND.

The Horn-Fly in Canada and Texas.—Mr. James Fletcher, Entomologist to the Canadian Department of Agriculture, announces[1] that the Horn-fly (*Hæmatobia serrata*) has appeared in enormous numbers in the Provinces of Ontario and Quebec, causing considerable anxiety to stock-owners. It was first definitely heard from at Oshawa, Ont., July 30, 1892. An excellent résumé of the life-history of the pest and of the means of preventing its injuries is given.

That this insect is also spreading rapidly in the southwest is shown by the following note from Dr. Mark Francis, of the Texas Agricultural College, who wrote me under date of Oct. 18, 1892, from College Station: "The horn-fly seems to be spreading westward. I saw it at Stillwater, Oklahoma, two weeks ago. It has not reached here yet, but I saw great numbers of them at Hempstead, Texas (forty miles southeast of here) last Friday. I think there can be no doubt as to its identity, as I have compared them with type specimens from Prof. H. Garman, of Kentucky."

Two days later Dr. Francis again wrote that the horn-fly was observed at College Station, Oct. 19, for the first time.

In Southern New Hampshire this insect has been very numerous the past season, and it has been gradually spreading northward through New England. But a hopeful report comes from New Jersey, where the insect was first observed. Prof. J. B. Smith states that it now causes little trouble there, and is seldom noticed as specially abundant.

[1] Central Exper. Farm, Ottawa, Bull. No. 14.

The Wheat Frit-Fly.—Dr. Otto Lugger reports[3] extensive damage to wheat in the northwest by a larva supposed to belong to one of the frit flies. The stem is injured about three inches above the ground, the larvæ occurring immediately above a node. The insect so weakens the plant at this point that the stalk falls over some time before harvest, the grains do not fill out, and reaper passes over the fallen stem. The puparia resemble the "flaxseed" state of the Hessian fly, and are found within the culm. It is supposed that the insect hibernates with the puparia. Burning and plowing under the stubble are the remedial measures recommended. This is apparently the worst frit-fly attack on wheat yet recorded in America. Dr. Lugger says that in many places fully one-fourth of the entire crop of wheat has been destroyed and in a great many more the losses amount to at least one-tenth.

Entomological Notes.—That excellent periodical, *Entomological News*, has instituted a department of economic entomology, with Prof. J. B. Smith in charge. This magazine will prove very useful to amateur as well as professional entomologists, and deserves cordial support. There has lately been a tendency to insert only very short articles, or to continue a single article through several issues (somewhat after the fashion of *Entomologica Americana*), which is unsatisfactory to all concerned.

Mr. M. H. Beckwith discusses[4] the injuries of the strawberry weevil (*Anthonomus musculus*) in Delaware, and reports finding the larvæ feeding upon the ovaries of strawberry blossoms. He surmises that there may be two or possibly three broods each year, but has been unable to trace the life-history of the insect during the latter summer months.

Concerning the recent bestowal by the University of Heidelberg of the honorary degree of Doctor of Natural Science upon Baron C. R. von Osten Sacken, Prof. S. W. Williston writes:[5] "Baron Osten Sacken's work has been chiefly related to American Dipterology, but the ripe fruits of his wide experience and broad grasp of principles have enriched all dipterology, and, I believe, all entomology. Others there are and have been who have won enviable honors in systematic dipterology; others who have written more extensively than he, but no one has written more that will be appreciated in the future than has Baron Osten Sacken.

---

[3] Minn. Exp. Station, Bull. No. 23.

[4] Delaware College Exp. Station, Bull. No. xviii.

[5] *Psyche*, Vol. 6, p. 346.

Dr. J. C. Neal discusses[6] a number of injurious insects that have appeared in Oklahoma. He includes *Pieris rapæ, Plusia brassicæ, Heliothis armigera, Diabrotica vittata, Lytta cinerea, Oncideres cingulata*, and *Blissus leucopterus.*

The recent biennial report of Prof. S. A. Forbes as Director of the Illinois State Laboratory of Natural History, shows that entomological studies are being vigorously prosecuted in that favored State. Fully 20,000 specimens have been added to the pinned collections, and 2700 bottles and vials to the biological series. We are glad to note the announcement to two important papers soon to appear in the Bulletin of the laboratory, the first by Mr. John Marten, containing descriptions of new species of Illinois gall gnats, and the second by Mr. C. A. Hart, a descriptive list of the aculeate Hymenoptera of Illinois.

PSYCHOLOGY.

Notes on Habits of Certain European Birds.—M. Ch. von Kempen has recently published some observations on birds from which the following extract is quoted to show the voracity of the ordinary sparrow-hawk (*Accipiter nisus*):

"For several years I lived in the country, and was accustomed to write during the summer near an open window. The apartment had from one side a view of the garden; from the other one looked out over the fields. Suddenly I saw a sparrow-hawk dart through the room; he flew with such violence that he broke the glass of the window, against which he dashed in his impetuous flight. I soon had an explanation of the circumstance. A linnet (*Sylvia hortensis*) perched near me was evidently the attraction. The warbler had flown into the room to escape the hawk, which in headlong pursuit, had gone through the room like an arrow from a bow.

"In February, 1889, I had in my town garden a certain number of lapwings (*Vanellus cristatus*); each evening, when I would go to shut them up in a cage, I would find one less than I had counted in the morning; I attributed this loss to a cat belonging in the neighborhood. The third day on missing another of my pets, I resolved to discover the thief, and concealed myself for that purpose. In the morning I saw a sparrow-hawk coming straight to my garden from the old tower of Saint Bertin. In spite of my presence he tried to carry off his daily meal, but I struck him with my hands and made him drop his prey. I then put my lapwings in their cage, as I was expecting to go out after dinner. What was my astonishment on going to see my birds in the evening to find the sparrow-hawk keeping them company in the cage. He had forced himself in through the bars but could not get out in the same way, and so was a prisoner with the lapwings, which he had not, as yet, dared to touch. The hawk was a young male, and now forms a part of my natural history collection."

---

[6] Oklahoma Agri. Exp. Station, Bull. No. 3.

Two other citations show that birds can familiarize themselves with objects which ordinarily terrify them.

"The jackdaws (*Corvus monedula*) and barn-owls (*Strix flammea*) are very numerous in all the towers of Saint-Omer; they are so accustomed to the noise of the clocks that they build their nests against the clappers.

"Last year I saw a nest of a titmouse (*Parus major*) built in a little mill that children played with in a garden. This noisy scarecrow, turning with every wind, did not frighten the saucy birds, and they reared their young with comfort.

"I now give two observations of another sort that prove beyond a doubt that birds possess a memory:

"I had in the country two domestic peafowls (*Pavo domesticus*); they were accustomed to come every evening to get their slice of bread cut in small bits before perching themselves on the roof; and if they were forgotten they would wait nearly all night before abandoning all hope of the treat. They were so tame that the male, as well as the female, would eat from our hands. After I had gone to the city, in order to keep the peafowls out of the garden, where, it is well known, they cause great havoc among the vegetables, the berries, and the currants, they were given corn in abundance in a place quite remote, but they declined these overtures and returned constantly to the place where I had fed them; I found them there on my return the following year. During the summer the female laid ten eggs, a less number than usual; nine young chicks were born; which, following the example of their parents, came every evening to look for their repast.

"During the winter a storm, accompanied by a fall of snow, burst upon us during the night, and the unfortunate peafowls were thrown from their perch on the roof; some wandering dogs strangled them, and we found their remains scattered over the field.

"I have at this time two laughing gulls (*Larus ridibundus*) living. I give them twice a day, at regular hours, bits of meat. Some jackdaws (*Corvus monedula*) come every day, at the exact hour, never too soon, never too late, from the towers of the Chapel of the Lyceum, an old church of the Jesuits, to snatch from me, or from any one who takes my place, the bits of meat that we give to the gulls.

"Last year a dwarf hen which belonged to me chased from its nest a female pigeon which had been setting for two days, broke up the eggs, and laid one of its own in the nest. The pair of pigeons continued to care for the egg of the hen, and, at the end of twenty-one days (which was really twenty-three for the pigeons) the chick came out of the shell. To see the efforts of the parents to feed it was curious. The second day, seeing that their efforts were in vain, I gave it some moistened bread, then I put it under the pigeon; so matters went on for three days, but the chicken wished to run about and I was obliged to take it from its adopted parents."—Bull. Soc. Zool., No. 4, 1892.

A Nest Building Frog.—In your issue for May, 1889, page 383, you published a paper in reference to certain batrachian nests discovered by me at Nikko in Japan. This summer I was shown by Dr. Guenther, at the British Museum, a couple of similar structures, though very much smaller in size, preserved in alcohol, and which had been received by the Museum from Japan. One of them had been taken from a shrub growing in the mouth of a well. Dr. Guenther told me that this nest is referable to a species of Polypedates. Day before yesterday I received a letter from my friend, Dr. A. C. Good, who is at present conducting a series of explorations in German West Africa. I take the liberty of transcribing a portion of the letter as follows:

"I desire to write you of something I saw on my last trip. As we brushed against the bush, that frequently overhung our path, I several times noticed, now on my shoe, now on my knee, a white froth. I thought it belonged to some insect, but for a long time I only noticed the white foam-like substance when I had gotten past the bush from which I had brushed it.

"At length, however, I brushed off a large bunch of substance, and when I tried to brush it from my clothes I uncovered some small creatures which wiggled about in it and evidently made this froth-like matter their home. On closer examination I discovered, very much to my surprise, that they were tadpoles.

"Later on I found on the underside of a leaf, a mass of this white substance that had not been disturbed since it had been placed there by the mother frog. I take it for granted that these tadpoles produce tree-frogs. The nest was about three inches long, by two or two and one-half inches wide, and nearly an inch in depth. In the inside and at the edges the frothy mass was quite white, and in consistency resembled the white of an egg after being thoroughly beaten. The lower face of the nest had taken on a yellowish tinge from long exposure. In this I found eggs, or semi-transparent jelly-like bodies as large as a small pea, which had already some power of motion, and on a few of which the tail was just beginning to take form. In another nest I found similar eggs just developing and also well-developed tadpoles. These last were about one-eighth of an inch in length and had tails one-half of an inch long. They seemed to move with difficulty through the mass.

"I wonder whether this froth is at once home and food to them, but am unable to say. These nests are frequent everywhere except near the coast. I saw none nearer than ten miles from the beach.

"I remember your saying something about finding tadpoles in trees in Japan, and I have the impression that you published something on the subject. If so this will be of interest to you."

Whether the creatures, the young of which Dr. Good found in this frothy mass were the tadpoles of *Chiromantis guineënsis,* to which a similar habit is ascribed by Bucholtz, of course I cannot say.—W. J. HOLLAND, Chancellor Western University of Pennsylvania.

Horse "Human Nature."—My son writes from a Wyoming ranch that a blind bay mare is ostentatiously protected by a black mare, the two having been raised together.

The blind horse would suffer greatly for feed, water, and from herd interference if the black were not constantly on guard. The latter watches the bay and grazes in a circle about her, keeping other horses at a distance by kicks and bites if necessary, selecting good grazing spots and watering places.

The guardian is rewarded with occasional kicks and other human-like evidences of gratitude.—S. V. CLEVENGER.

ARCHÆOLOGY AND ETHNOLOGY.

Legendary Evolution of the Navajo Indians.[1]—The Navajos once lived in a world below this earth. The tribe had twelve chiefs, and the chief had four wives. This head chief arose early in the morning and commanded his people to go to work. One morning he failed to arise. The third morning he failed to arise. The fourth morning he made no appearance. On the fifth morning the Navajos became uneasy, and went to find their chief. The other eleven chiefs wondered what became of him, and when they found him they learned that his oldest squaw had left him, and had married another man. The old chief grieved very much and refused to be comforted.

In a short time the squaw came in and said, "I have left you because I have ceased to love you. I can make my own living, and you can make yours." So they had a row.

This woman was chief of the women of the tribe.

Then the squaw called all of the women to council and said, "Let us part from the men!" So the women said, "Take all the men, boys, and male babies and cross the large river.[2] Burn logs out to make the canoes, and stay over there four years."

They gave the male children into the hands of some hermaphrodites, who raised them on the brains of wild sheep and deer.

The men sailed across the large river, planted large fields of corn, and raised immense crops. The first year the women raised a fair crop; the second year they raised less; the third year they had hardly enough to eat; and the fourth year was a complete failure.

The women became discontented, and were in a starving condition. Some of them ran into the river and were drowned.

---

[1] These legends were collected by the writer while employed in the Indian service at the Navajo Indian agency. They were related by Tsĕ-dĭ-ăhl-hă′-ŭn-be·gĕh, or Rocking Sun, the great Lightning Medicine-Man of the Navajos. These legends were carefully interpreted, and are given word for word as they were related.

[2] The "Happy Hunting-grounds" of the Navajo Indians are represented as a land full of forests and lakes which abound in various kinds of game and fish. Flowing through the center of this land is a huge river which separates the braves and pretty maidens from the inferior members of the tribe and the old women.

So the women begged the men to come back to them. The woman-chief admitted that she had done wrong, that the women could not make their living, and that the men could not make their living.

Then the young chiefs held a council and said, "Let us go back to the women in four days, or they will die." So in four days they went back to the women, and had a feast of deer meat and love-making.

While they were having a good time the Coyote picked a young whale out of the water and hid it under his blanket. On the fourth morning after this, when they awoke, they saw a large blue wave of something coming from the east. The old chief sent an Indian to see what it was. The Indian returned and said that it was water. They looked to the north and saw a big white wave coming. The chief sent an Indian to see what it was. The Indian returned and said, "It is water." They looked to the west and saw a black wave coming. The chief sent an Indian to see what it was. The Indian returned and said, "It is water." Then they looked to the south and saw a green wave coming. The chief sent an Indian to see what it was. The Indian returned and said, "It is water." Then the chief called the tribe to council and said, "Something is wrong, we all will be drowned."

At that time the Navajos were animals and had squirrel blood in them. So the White Squirrel planted a pine tree; the Gray Squirrel planted a rattoon tree; and the Turkey planted a pipe-stem reed. The Navajos all ran into this reed and began climbing up on the inside. The reed grew very fast, even faster than they climbed. The water began rising higher and higher, and followed close to their heels. The Coyote was among them. The Badger went up first, making way for the rest with his paws. The Badger consoled the rest by saying, "I am very near the top of the earth." In getting his feet muddy his legs and feet have remained black from that time. The Turkey came up last, and the foam of the water touching its tail caused its tail-feathers to be tipped with white from that time.

Finally they came up through a lake, and they knew they had reached the top of the earth.

The Badger looked out and said, "I see a big Water Animal and some Big Men who are very mean." Then they sent the Locust out to see what kind of an earth this was. A big White Bird came from the north, met the Locust and said, "Things like you are not to be seen here!" Then the Locust replied, "We will see about this." A Yellow Bird came from the west, a Black Bird came from the south, and a Blue Bird came from the east, and they all said, "Things like you are not to be seen here." But the Locust said, "We will see about that. If you will do as I do you may have this land; but if you do not do as I do I will beat you." The Locust had two arrows. He stuck one of them up through his body and the other one down his mouth. Then he took the two arrows and crossed them through his heart. He next threw the arrows at the White Bird and said, "If you do not do as I have done I will beat you." The White Bird took the arrows and pretended to do these things, but he only ran the arrows through his feathers.

There was so much water that the Locust could not bring his companions up out of the reed. So he took a mountain-sheep's horn and broke the land to the north and to the south and to the west and to the east, and the water all ran off. The Locust then went back and brought his companions out of the hole which the Badger had made. But the water still followed them up through this hole.

Then the chief said, "Some one has been playing a trick." He said to the Coyote, "You are always up to some meanness! What have you under your blanket?" The Coyote opened his blanket, showed the young whale to the chief, and then dropped it down this hole. The water immediately went back down the reed into the river. They all came out, but could not walk because of so much mud. Then the chief prayed to the wind, and the wind dried the mud.

The Navajos were now changed to people, but they did not know what to plant. The Turkey flew up, and the first time he dropped some yellow corn; the second time he dropped some red corn; the third time he dropped blue corn; and the fourth time he dropped all kinds of corn.

The Navajos then made hō′-gäns (houses), and the women and children played in them while the men worked. Some of them made houses in the rocks.

The chief then said, "We will see if there will be any deaths up in this world. I will throw a big log into the water, and if it sinks, we will each one have to die; but if the log floats, we will never die."

Then the Coyote tied a string to a rock and said, "I will throw this into the water, and if it sinks we will each have to die, but if it comes up and floats, we will never die."

The chief then said to the Coyote, "You are always doing some mean trick!"

But the Coyote said, "I cannot help it. If the Navajos never die, we will always be the same; but if the Navajos die, we will all be different. We all have children, and if none ever die, this earth will not hold us."

On the fourth morning, one of their number died. They all looked for this one, but they could not find him. Then they looked down this hole which they came out of a few days before, and they saw this man down there combing his hair. This man looked up and said:

"I am happy down here. In time, you all will be down here where I am." Then there was a famine, and about half of them died.

THE MYSTERIOUS MAIDEN.

There was a little girl found at daylight one morning. The woman who found her claimed that she was the "Mysterious Maiden," and so another woman took her and raised her. This child soon grew to womanhood.

This maiden conceived from a piece of petrified wood and bore a Giant. She conceived from a feather and bore a Large Bird. Then she conceived from a horn and bore a Large Animal (something like a buffalo), which ate the Navajos. She next conceived from a berry and bore a Bear. She then rubbed herself against a rock. Behind this rock was a patch of berries. When the Navajos went to gather the berries, the rocks would crash together and kill them. The sides of the rocks were covered with blood. The maiden then conceived from a reed and bore a patch of reeds. If a Navajo went into these reeds, he never was seen again. She next conceived from a battle-axe, and bore an Old Hag who lived among the rocks. This Old Hag would moan and cry for some one to come and kill her. When a Navajo went to kill her, she would blow on the battle-axe and the axe would kill the Navajo. She then conceived from a hair, and bore an Animal Whose Hair Grew Fast to the Rocks. This Animal stood on the brow of a precipice. Over in a corner of his den were some beautiful arrows. This Animal would tell the Navajos to come and get those arrows, but when they went there he would kick them over this precipice, and his children, who lived down below him, would devour them. Next, this maiden conceived from the sand and bore a pair of Big Eyes. At night, those Eyes shone like a big fire, and they would hollow for people to come over there. Then the Eyes would pierce their hearts and kill them. She next conceived from an antelope-hoof and bore Twelve Antelopes, who used to destroy Navajos. Lastly, she conceived and bore two sons. The oldest boy was conceived from the sun, and the younger one from the water. These boys were going to kill all of these animals which destroyed the Navajos, but the Navajos were nearly all killed before this time. These boys grew up to be very large, had bows and arrows, and they used to run off. One day these boys asked their mother who their father was. She replied. "The cactus and the water." But the oldest boy said, "I do not believe this." Then the mother said, "The sun is your father, but he lives a long way off."

ORIGIN OF THE YĀY′-BĬ-CHȲ́S.[3]

The father of the Red Yaybichy was the sun. The father of the White Yaybichy was the water. The Mysterious Maiden[4] conceived from the sun and bore the Red Yaybichy. She conceived from the water and bore the White Yaybichy.

This Mysterious Maiden was out picking up wood, and was going to put it on her back, when the sun came up to her, dressed in turquois, beads, feathers, and fine skins. He told this maiden to be by herself that night, and he would come to her.

The Mysterious Maiden went home and told her father what the sun had said. The sun came and talked with her, but she did not know it; but she heard a noise going out from the hogan (house) where she stayed. She saw this man (the sun) four days afterward, and told her father that this was the same man she saw while picking up the wood.

She saw the sun abusing himself at daylight, and this made fleas and mosquitos.

In four days, these two sons were born to the Mysterious Maiden, and in four days more, these sons went up to visit their father.

The younger son had a cedar bow, and the older son had a piñon bow. They started toward the east to see their father.

The Black Yaybichy met them there and told them to go back. He told them that there were oceans and cañons and deserts and cactus fields and great fires and great wolves and great snakes and great bears that would destroy them, and said, "Your father lives a long way off."

---

[3] For a description of the Yaybichy Dance of the Navajo Indians see pages 435–436 of the Annual Report of the Bureau of Ethnology for 1883–'84, by Dr. Washington Mathews, U. S. A., under the direction of Major J. W. Powell, director of U. S. Geological Survey.

The Yaybichy medicine-men are the leading medicine-men of the Navajo tribe, and play an important part in all their religious ceremonies and fetichistic mysteries.

[4] The same maiden referred to in the Legend of the Mysterious Maiden.

These boys[5] (the Red and White Yaybichys) went by a large ocean, and looked down into the valley, and saw the smoke coming out of the ground. Here lived an old Woman-spider. When the boys came up the Spider said, "Hallo, grand-children, where did you come from? People of your class never come here! This place is not for you!"

"Our mother told us to go to see our father, the sun," said the boys.

"But your father lives a long way off, and he is not a good man. He will kill you with sweat-houses and red-hot irons."

Then this old Woman-spider gave them each a white feather, and told them it would be a Spirit to guide and defend them. Then she said, "Stop here to-night with me."

The boys said, "We can not get through that hole in the ground."

Then the old Woman-spider blew into the hole and it became larger. She then vomited, and gave them (the boys) their suppers.

The sun was now straight over their heads. The boys told the old Woman-spider that they wanted to get as far as they could before sundown.

The old Woman-spider was a spirit; so she pulled the sun down with a net and then told the boys that it was now sundown. The boys stayed all night, and they grew to manhood during that night.

The Black Yaybichy met them again, and told them that they would reach their destination about noon that day, and that their father would come to them at that place at night.

At noon that day they saw a big house and started to go in. Two big bears met them and snarled, but the boys said, "We are going to to see our father." Then the bears lay down and the boys passed over them. They next met two large, vicious snakes. The snakes rattled and hissed, but the boys said, "We are going to see our father." Then the snakes lay down and the boys passed over them. They next met two big lightnings and thunders. These stopped the boys, but the boys said, "We are going to see our father." Then the lightning lay down and the boys passed over it. They next met a number of little snakes of various kinds. The boys said, "We are going to see our father." Then the snakes lay down and the boys passed over them. They next met the sun's young wife. The boys said to her, "We are going to see our father." The young wife replied, "What are you doing here? Boys like you and people of your class are not allowed here." But the boys replied, "The sun is our father." Then the young wife wrapped them up in a white cloud that pointed toward the north. She also made a black cloud that pointed toward the east; a yellow cloud that pointed toward the south, and a red cloud that pointed toward the west. It was now pretty near night (sundown).

---

[5] The boys referred to in the Legend of the Mysterious Maiden.

The sun had two children by this young wife, a girl and a boy.

The boy spoke and said, "I hear my father coming home, for I hear the white gourd rattle."

The girl spoke and said, "My father is coming, for I hear the blue gourd rattle." Then the boy said, "My father is coming home, for I hear the ivory gourd rattle." The girl spoke and said, "My father is coming close, for I hear the turquois gourd rattle."

At that moment the father came, making a fearful noise rattling the irons on his body.

The sun demanded of his young wife who those two young men were that he saw come into the house, but did not see go out again.

The wife replied, "You think you are pretty cunning. You told me that you had no wife but me. These young men claim to be your sons."

At this the sun became angry and rattled his gourds, and the earth began to tremble, the lightning flashed, the bears roared, and the snakes rattled and hissed. The sun then demanded where the two young men were, but the wife made no answer. He demanded this again, but no answer. He then demanded the fourth time, but still the wife refused to answer. Then the sun went to the cloud in the east, and knocked that down; but no one fell out of it. He went to the cloud in the west, and knocked that down; but no one fell out of it. He went to the cloud in the south, and knocked that down; but no one fell out of it. He went to the cloud in the north and knocked that down, and the boys fell out of it and stood before him.

All at once four sharp irons, corresponding to the four clouds, pointed toward the boys. There was a white iron from the north, a black iron from the east, a yellow iron from the south, and a red one from the west. The sun threw the boys violently against these irons, the north one first, then the east one, then the south one, and then the west one, but this white feather which the old Woman-spider gave them would let them down easy; so they remained unhurt.

The sun became angry and said, "I will find out if you are my children. If you withstand my test you are my children." Then a spirit descended and stood on each of their ears, and told the boys how to answer the sun's questions. It said, "Tell him he is your father." Then the sun took a huge turquois hammer and tried to mash the boys, but the feathers made the turquois hammer come down easy. The sun then made the boys smoke some poison in first, a turquois pipe, and second, in an ivory pipe. He did this the second time, and still the boys were unhurt.

The sun said to his servants "Make a sweat-house and put four irons in it, one of the irons shall be white, one blue, one yellow, and one black, and make the house boiling hot."

Just as the boys started to go into the sweat-house a Gopher came up through the ground and told the boys to crawl into his hole. The hole was inside of the sweat-house.[6]

The Gopher said "If you stay in there the sun will throw water on the irons and the irons will break and kill you." So the boys went into the Gopher's hole. The Gopher then said, "If your father asks you if you are warm you go out of the hole and say, yes. You can thus fool him. He will throw the water, but you will be safe in this hole. He will then be through with you."

The sun placed a blanket over the mouth of the sweat-house and did as the Gopher had said. When the sun looked in he saw the boys sitting there unhurt. Then he kissed the boys and told them that they were his sons, and that they had gone through with all of the forms that could kill them. The sun then took the boys home with him and made his other son and daughter shake hands with them.

The young wife was then in a good humor, and dressed up her step-sons. One of them she painted red, with white streaks down his back, representing the lightning; the other one she painted white.

The sun then asked the boys what they wanted as a gift. The Spirits on their ears said, "do not answer him until he asks you another question." The father took them through a large iron gate to the east and showed them fine horses of all colors. The father said, "Boys, do you want these?" The Spirit said, "Tell him no." Then he opened a large iron gate to the north and showed them some fine sheep, and said, "Do you want these?" The Spirit said, "Tell him no." He next opened a large iron gate to the west and showed them some fine goats, and said, "Do you want these?" The Spirit said, "Tell him no." He then opened a large iron gate to the south and showed them deer, buffalo, antelope and all kinds of game, and said, "Do you want these?" The Spirit said, "Tell him no." The father then brought the boys home, and said, "My children, what can I do for you?"

---

[6] The Navajo Indians have sweat-houses at the present day. The house is made in a hemispherical form. Its first roof consists of poles, the second one is stones, and the third one is dirt. A hole is left in one side for ingress and egress. The house is usually located in close proximity to some stream or pond, and is used for medical purposes. Rocks are heated and thrown into the sweat-house and water is thrown on the heated rocks, causing steam to fill the apartment. The patient now goes into the sweat-house and covers the door with a blanket. After a time he comes out and plunges into the adjoining lake or river. This process is often repeated in winter.

The boys looked and saw four lightning arrows and a huge bow hanging on the wall. The spirit said, "Tell him that you want these; that some animals, a Huge Giant, Twelve Antelope, a Huge Bird, an Animal Whose Hair Grew Fast to the Rock, are eating all the Navajos. Those arrows will kill them."

The sun replied, "The Giant[7] is my son and your brother, but if he is eating the Navajos you have my permission to kill him. He has no right to live. I will take you and go to-morrow morning."

On the following morning they started, and came to Sanmateo Mountain[8] about noon. The sun said, "Boys, where did you start from?" The Spirit said, "Tell him that it was from here; that here is where the Big Giant was." Then the sun let the lightning down, and the boys climbed down the lightning to a big spring at the foot of the mountains.

The Giant drank the water from the spring, and then lay down on a rock to rest. He did this the second time and the third time and the fourth time. As he turned his face toward the north the boys saw him lying on the rock. The Giant turned his face toward the east, and they could see his shoulders. He turned his face to the south, and they could see his waist. He turned his face to the west, and they could see his whole body.

The Giant now saw the boys and said, "Will not they make fine eating?" The Spirit said, "Tell him that he will make fine eating." The giant then flew in a rage and threw an iron boomerang at the head of the older boy. The Spirit said, "Stoop low, for he is throwing at your head." The Giant then threw one at his middle; the Spirit said, "Jump to the right or he will hit you." He next threw one very low, and the Spirit said, "Jump high, for he is going to throw it low."

The sun then appeared and said, "He is my son and I will have the first chance at him." Then the sun struck him with the lightning. The Giant fell to the earth and grew weak because he lost his blood.

---

[7] The same giant referred to in the Legend of the Mysterious Maiden.

[8] Sanmateo Mountain, or Mt. Taylor, is about forty miles from Fort Wingate, New Mexico. It seems to be the seat of nearly all the gods and demons of which the Navajo mythology is so replete. Dr. Mathews refers to it several times in his "Mountain Chant," found in the annual report of the Bureau of Ethnology, 1883–'84, J. W. Powell, Director.

The black rocks (igneous rocks) are his blood, and the petrified wood is his bones. The Spirit then said, "Do not let his blood run together, or he will get up again." His blood ran down the hill.

The boys then shot him with the four arrows which their father had given them, and killed him. The younger boy picked up the iron boomerangs and kept them. The younger boy was given the turquois gourd from his father.

They then saw these animals—the Buffalo, the Twelve Antelope, the Large Bird, and the Animal Whose Hair Grew Fast to the Rocks over in a little valley. They shook this turquois gourd at these animals and the animals all died.

The boys then went to the Cañon de Shelley[9] and went into one of the cliff-dwellings, known as the "White House," and disappeared, forever to remain as Yaybichys.

THE MISSION OF THE YAYBICHYS.

A man was once struck by lightning and knocked all to pieces. The Yaybichys came and sang over him and brought him to life again. The White Yaybichy was the first one who came. This one went over his body from east to west, from west to east, from north to south, and from south to north, and had four songs. This one picked up his meat.

The Black Yaybichy did the same as the white one.

The Red Yaybichy came, and when the man came partly to life he came from the east, and had a gourd in his hand, and made a noise like lightning. He came from the south and made another queer noise. Then he came from the west, and then from the north, and shook the gourd[10] over the dead man's head.

The gourd represents the noise of the lightning when it strikes a person.

The White Yabichy took the man home, after he got alive, and showed him all these medicine things, and how he worshiped them.

---

[9] Pronounced de Shāy. It is a beautiful little cañon situated about fifty miles from Fort Defiance, Arizona Territory. It contains many cliff dwellings, among which is the one known as the "White House," (because of its whitened walls) which is visited by numerous adventurers every summer. Most of the walls remain at the present day. There are now twenty-six Yaybichys in the Navajo tribe, including the sun and these two boys.

[10] The turquois gourd referred to in the Origin of the Yaybichys. The medicine-men of to-day seem to have unlimited faith in the turquois gourd.

This Yaybichy took him to Sanmateo Mountain and told him these things. He told him that a thousand years from this time the people would follow the teachings of the Yaybichys, that his son and his son's son through a period of a thousand years would be able to bring people back to life.

Then the Red Yaybichy took this man to Sanmateo Mountain and shook the gourd over him and told him how to wave the gourd over the dead man, from east to west (from sunrise to sunset), and from north to south. Then this man came back into the Navajo tribe and showed them how to use the medicine things,[11] and he was a great medicine-man.

But when this man came back and the Navajos broke their arms and legs, then they used these same medicine things, and they got well. So that made the Navajos have confidence in the medicine-man and the medicine things.

When any one gets sick we rattle the gourd over him and he gets well.

These two Yaybichys, the red one, called Yä-nä′ Yä-zän, and the white one called Tō-wäzh-zhŭs-chĭ′-nĭ, were made on the top of Sanmateo Mountain.

There were some animals that ate the Navajos at that time, viz., a Bear, a Large Bird, a Huge Giant, and a Fierce Animal Whose Hair grew Fast to the Rocks, and which coaxed the people to pass that way, when he would kick them down over the rocks and then go down and eat them up.

There was another fierce animal which chased the Navajos, killed them, and devoured them.

The Red Yaybichy killed all these animals[12] off.

There was a sister who had twelve brothers. This sister became a bear and killed the twelve brothers. Then the White Yaybichy killed this sister.

The father of the Red Yaybichy was the sun. The father of the White Yaybichy was the water.—T. Stanton Van Vleet.

---

[11] The "medicine things" referred to are the things which are used by the Yaybichy medicine-men at the present day. They consist of five pieces, each one of which performs a specific duty in restoring the health of the patient. The medicine-men claim that these "medicine things" have been handed down from generation to generation since the origin of the Yaybichys.

[12] These are the animals to which the "Mysterious Maiden" gave birth. They seem to have a significant place in Navajo mythology, and find their way into a large number of their legends.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—At the meeting of the Biological Section, Nov. 14, Prof. H. F. Osborn was elected chairman, and Bashford Dean secretary. The papers of the evening were:

Arthur Hollick, On Additions to the Palæobotany of the Cretaceous of Staten Island. These include about forty species not previously recorded from eastern North America, although in part described as occurring in the cretaceous of Greenland and in the Laramie. About fifteen new species were recorded, representing *Populus*, *Platanus*, *Myrica*, *Kalmia*, *Acer* and *Williamsonia*. The fossils were in the main taken from fire-brick clay. H. F. Osborn, Report Upon a Collection of Mammals from the Cretaceous (Laramie). The multituberculates *Meniscoëssus* and *Ptilodus* were assigned to the Plagiaulacidæ, the former a probable ancestor of *Polymastodon*. The relations of these mammals were shown to be closer to Puerco than to upper Jurassic forms. Arthur Willey, On the Significance of the Pituitary Body, suggesting from studies on Ascidians and Amphioxus a primitive monorhinic condition in vertebrates. The nasal sac of Petromyzon is of secondary nature, as shown by development (Dohrn) and nerve supply, but the nose in the monorhinic ancestor of vertebrates was the pituitary body of existing forms, this being represented in Ascidia, as shown by Julin, by the sub-neural gland and its duct, and in Amphioxus by the so-called olfactory pit. The pituitary body is to the lateral nares what the pineal body is to lateral eyes.

Bashford Dean exhibited an entire *Ctadodus*, a unique specimen recently collected in the Cleveland shales. The tail is for the first time shown, and indicates historically the origin of the ray parts of this organ in modern elasmobranchs.

Nebraska Academy of Sciences.—The annual meeting was held December 26 and 27, at Lincoln. Prof. Bessey was Chairman and Prof. A. H. Van Vleet, of Peru, Secretary and Treasurer. The following papers were read:

Psychology a Science, Dr. D. R. Dungan; Evidences of two Premorainic Glacial Movements, Prof. G. D. Sweezey; Evolution of the Loup Rivers, Dr. L. E. Hicks; Some Notes on the Fringillidæ of Nebraska, D. A. Haggard; The Myriapoda of Nebraska, F. C. Kenyon; The Canyon Flora of Northwest Nebraska, A. F. Woods; Notes on the Flora of the Black Hills of South Dakota, P. A. Rydberg; Notes on Nebraska Phosphates, H. E. Fulmer; Some Notes on Mineral Water from Odell, Nebraska, Rosa Bouton; Systems of Notation in Numbers, Dr. H. E. Hitchcock; The Flora of Long Pine Canyon, Julius Conklin; The Flora of the Sand Hills, Roscoe Pound; A New Miocene Rodent, Prof. E. H. Barbour; The Fishes of Nebraska, M. E. O'Brien; Descriptions of Some New Nebraska Orthoptera, L. Bruner; Catalogue of the Orthoptera of Nebraska, L. Bruner; Notes on the Composition of the Lincoln City Gas Supply, Prof. H. H. Nicholson; The Relationship of the Nebraska Flora to That of the Regions Further West, H. S. Clason; The Erysipheæ of Crete, W. H. Skinner; The Fresh-Water Algæ of Kearney County, Nebraska, Dr. H. Hapeman; Some Mexican Lichens, Prof. T. A. Williams.

Boston Society of Natural History.—November 16.—The following paper was read: The Origin of Drumlins, Mr. Warren Upham; Profs. Shaler and Davis also spoke on the Origin of Drumlins.

December 7.—The following papers were read: Some Indian Quarries in Arkansas, Mr. Leon S. Griswold; Notes on a New Order of Schizomycetes (Bacteria). Specimens were shown with both papers.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—November 19.—The following communications were read: On Certain Minute (parasitic?) Bodies Within the Red Blood Corpuscles, Dr. Theobald Smith; The Topographical Relations of the Excretory Canals of Cestodes, Dr. C. W. Stiles; A Walchia from New Mexico, Mr. David White; Some Entomological Factors in the Problem of Country Fences, Mr. F. M. Webster; Comparative Value of Plants in Determining Floral Zones, Mr. F. V. Coville.

December 3.—The following communications were read: The Cruise of the U. S. Fish Commission Steamer Albatross in Alaskan Waters in 1892, Prof. B. W. Evermann; Some New Grasses, Dr. George Vasey; On the Rediscovery of Certain Rare Plants, Mr. J. N. Rose; Exhibition of a Complete Series of the Large American Ground Squirrels of the Subgenus Otospermophilus, Dr. C. Hart Merriam; The Mathematics of Forest Growth, Dr. B. E. Fernow.

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—November 15.—The following papers were read: Singular Copper Objects from

Ancient Mounds in Ohio, Mr. Warren K. Moorhead; Geographic Nomenclature of the District and Vicinity, a Symposium, Mr. James Mooney, Prof. Lester F. Ward, Mr. W. H. Holmes, Mr. W. Hallet Phillips, Mr. W. H. Babcock, and Dr. Frank Baker.

WESTON FLINT, *Secretary.*

SCIENTIFIC NEWS.

Prof. John S. Newberry, Professor of Geology in Columbia College, New York, died at New Haven, December 7. He was born at Windsor, Conn., in 1822, and was the descendant of an old and distinguished Puritan family. He was graduated from Western Reserve College in 1846, and from Cleveland Medical College in 1848. After two years' travel and study in Europe he established himself as a physician in Cleveland. He returned to his scientific studies, which had long been in abeyance, in 1855, when he accepted an appointment as acting assistant surgeon in the army, and accompanied, as surgeon and geologist, the expedition under Lieutenant R. S. Williamson, U. S. A., which explored the territory lying between San Francisco and the Columbia River. In 1857–'58 he was attached, in the same capacity, to the expedition under Lieutenant J. C. Ives, U. S. A., which made the first exploration of the Colorado River, one of the most important of the western territory surveys. Dr. Newberry, in 1859, participated in the exploration of the country bordering the upper Colorado and San Juan Rivers. During the war of the rebellion Dr. Newberry was a member of the United States Sanitary Commission, and directed its operations in the Valley of the Mississippi. In 1866 he was appointed professor of geology in the School of Mines, Columbia College. In 1869 he was appointed head of the reorganized Ohio Geological Survey, and under his direction the work was vigorously pushed to completion.

Prof. Newberry had probably seen more of the United States from a professional point of view than any other of our geologists. He will be best known from his work on fossil plants and fossil fishes. He was especially conscientious in his comparisons of American with European forms of extinct life that came under his observation. Personally he was of a rather impetuous temperament, whose strong friendships were offset by a spice of irascibility without malice. He will be greatly missed from his place in the scientific life of America.

Sir Richard Owen died December 18. He was born at Lancaster on July 20, 1804. He received his early education in his native town, and at the age of 20 he began a medical course in the University of Edinburgh. He completed his studies in London and Paris medical schools.

When 30 years old he was appointed to the chair of comparative anatomy at St. Bartholomew's Hospital, and two years later he succeeded Sir Charles Bell as Professor of Anatomy and Physiology in the College of Surgeons. He held the latter place for twenty years, leaving it only to take charge of the Department of Natural History in the British Museum.

He had the Cross of the Legion of Honor, was a Chevalier of the Prussian Order of Merit, and was one of the eight foreign associates of the French Institute. He was created a commander of the Bath in 1873, and subsequently was made K. C. B. Sir Richard Owen was the successor of Cuvier as the leader in the progressive advance of the science of comparative anatomy. He filled up many of the gaps unavoidably left by the great Frenchman, which he was enabled to do by the opening up of many parts of the world by British commercial and colonial enterprise. His contributions to paleontology are even more important, his researches having covered regions that Cuvier could not in his day reach. Antarctic paleontology was founded by him, for South America, South Africa and Australia yielded their treasures to him first of all. Besides being an accurate observer and describer he was a good systematist, many of the current terms of zoology having originated with him. In generalizations of a higher grade he was not active; the doctrine of evolution having arrived rather late to get that attention from him which its earlier advent would have secured.

Owen was a tall and stalwart man of spare habit. He was characterized by a mental and physical tenacity, which was exhibited in his psychic structure in the great difficulty he experienced in changing an opinion he had once formed. He was fond of diplomacy, and could dissect an adversary crosswise of the grain in the most bland and sympathetic manner imaginable.

Prof. J. T. Rothrock has resigned from the faculty of the University of Pennsylvania, and will occupy the position of Secretary of the Forestry Commission of Pennsylvania.

What is an Acquired Character ?—A Correction.—In the December number of THE NATURALIST, page 1010, occurs about as unfortunate an error in proof-reading as could have been made. The sentence "*I must confess my inability to see why this variation is not qualitative as well,*" is put in quotation marks, as if it were credited to *Weismann*. The sentence is my own, and would doubtless be indignantly repudiated by the great apostle of Neo-Darwinism, as it is flatly Neo-Lamarckian in fact.

In explanation I will simply add that I did not read the proof. The original manuscript in my possession is correct, although I am not positive that the typewritten copy forwarded to THE NATURALIST is not at fault.—C. C. NUTTING.

RECORD OF NORTH AMERICAN ZOOLOGY.

(*Continued from Vol. XXVI, p.* 798.)

Grote, A. R.—[Validity of] *Halisidota trigona*. Can. Ent., xxiii, 109, 1891.

Grote, A. R.—Note on Graphiphora Hubn. Can. Ent., xxiii, 101, 1891.

Grote, A. R.—The male genitalia and the subdivisions of Agrotis. Can. Ent., xxiii, 147, 1891.

Grote, A. R.—*Halisidota trigona*. Can. Ent., xxiii, 201, 1891.—Validity of.

Grote, A. R.—On *Catocala flebilis* and *C. fratercula*. Can. Ent. xxiii, 281, 1891.

Grote, A. R.—*Agrotis subgothica*. Can. Ent., xxiii, 202, 1891.—Reply to Tutt.

Grote, A. R.—An explanation. Can. Ent., xxiv, 17, 1892.—Reply to certain criticisms of J. B. Smith, as to arrangement of Heterocera.

Grote, A. R.—Remarks on Prof. John B. Smith's revision of the genus Agrotis. Can. Ent., xxiii 45, 1891.

Howard, L. O.—The larger corn stalk borer. Insect Life, iv, 95, 1891.—*Diatræa saccharalis*.

Hudson, G. H.—A new species of Cerura. Can. Ent., xxiii, 197, 1891.

Hulst, G. D.—Prof. J. B. Smith's List of Lepidoptera. Can. Ent., xxiv, 74, 1892.

Hulst, G. D.—New species of Pyaalidæ. Can. Ent., xxiv, 59, 1892.—15 sp., Ocala and Chipeta, nn. gg.

Kellicott, D. S.—Notes on two borers injurious to the Mountain Ash.—*Podoseiia syringæ*, *Zeuzophora semifuneralis*.

Kellicott, D. S.—Notes on the Ægeridæ of Central Ohio. Can. Ent., xxiv, 42, 1892.

Kellicott, D. S.—[Tortricid feeding on *Silphium perfoliatum*]. Can. Ent., xxiii, 218, 1891.

Lintner, J. A.—[An onion pest, *Agrotis ypsilon*]. Can. Ent., xxiii, 220, 1891.

Lintner, J. A.—On the eye-spotted bud-moth (*Tmetocera ocellaria*), in Western New York. Can. Ent., xxiii, 231, 1891.

LINTNER, J. A.—On some of our Orgyias. Can. Ent., xxiii, 232 1891.

LYMAN, H. H.—*Pamphila manitoba* (Scud.) and its varieties. 22 Rep. Ent. Socy. Ontario, 1891, 27. Can. Ent. xxiv, 57, 1892.

MOFFATT, J. A.—A microscopical examination of an unexpanded wing of *Callosamia promethea.* 22 An. Rep. Entom. Socy. Canada, 32, 1891.

MOFFATT, J. A.—Additions to the Canadian list of Microlepidoptera. Can. Ent., xxiii, 167, 1891.

MOFFATT, J. A.—*Melitta phaeton* [in Ontario]. Can. Ent., xxiv, 18, 1892.

MOFFATT, J. H.—*Petrophora silaciata.* Can. Ent., xxiv, 18, 1892. —Distribution and varieties.

NEUMÖGEN, B.—About Pseudohazis and its variations. Can. Ent., xxiii, 145, 1891.

OSBORN, H. and GOSSARD, H. A.—The clover-seed caterpillar (*Grapholitha interstinctana* Clem.). 22 Rep. Ent. Soc. Ontario, 74, 1891. Insect Life, iv, 56, 1891.

OSBORN, H.—*Asopia farinalis* as a clover pest. Can. Ent., xxiii, 283, 1891.

PACKARD, A. S.—Notes on some points in the external structure and phylogemy of Lepidopterous larvæ. Proc. B. S. N. H., xxv, 82, 1891.

PATTON, W. H.—Aphidivorous habits of *Teniseca tarquinius* (Fabr.) Grote. Can. Ent., xxviii, 66, 1892.

RILEY, C. V.—A new herbarium pest. Insect Life, iv, 108, 1891.—*Carphoxera ptelearia* n. g. and sp. Geometridæ.

SMITH, J. B.—Contributions toward a monograph of the Noctuidæ of Temperate North America.—Revision of Homohadena, Grote. Proc. U. S. Nat. Mus., xiii, 397, 1891.—*H. deserta* nov.

SMITH, J. B.—Contributions, etc., Revision of the species of Hadena referable to Xylophasia and Luperina, l. c., p. 407, 1891.—*X. cogitata, alticola, nigrior, antennata, centralis,* are new.

SMITH, J. B.—Remarks on the classification of the Lepidoptera. Can. Ent., xxiii, 245, 1891.

SMITH, J. B.—Notes on blackberry borers and gall makers. Insect Life, iv, 27, 1891. 22 Rep. Ent. Soc. Ontario, 52, 1891.—Bembecia.

SMITH, J. B.—*Limenitis arthemis,* etc. Can. Ent., xxiii, 104, 1891.

SMITH, J. B.—The squash borer, *Mellitia cucurbitæ,* and remedies therefor. 22 Rep. Ent. Soc. Ontario, 55, 1891. Insect Life, iv, 30, 1891.

Smith, J. B.—*Halisidota trigona* Grt. Can. Ent., xxiii, 158, 1891.

Smith, J. B.—Prof. J. B. Smith's List of Lepidoptera. Can. Ent., xxiv, 103, 1892—Reply to H. G. Dyar.

Townsend, C. H. T.—*Chilo saccharalis* in New Mexico. Insect Life, iv, 24, 1891. 22 Rep. Ent. Soc. Ontario, 50, 1891.

Tutt, J. W.—*Agrotis subgothica* Harr. Can. Ent., xxiii, 159, 1891.

Van Duzee, E. P.—List of the Macro-Lepidoptera of Buffalo and vicinity. Bull. Buff. Soc. N. H., v. 105, 1891.

Webster, F. M.—Some studies of the clover hay worm, *Asopia costalis*. Insect Life, iv, 121, 1891.

Winn, A. F.—Some rare Lepidoptera taken near Montreal. Can. Ent., xxiii, 96, 1891.

Wright, W. G.—Getting butterfly eggs. Can. Ent., xxiv, 70, 1892.

DIPTERA.

Alwood, W. B.—A note on remedies for the horn fly. 22 Rep. Ent. Socy. Ontario, 83, 1891. Insect Life, iv, 68, 1891.

Curtis, C.—Oxwarble in the United States. Jour. Comp. Med. and Veterin. Archives, June, 1891.

Coquillett, D. W.—Revision of the Bombylid genus Aphœbantus. W. A. Scientist, vii, 254, 1891.

Coquillett, D. W.—New Bombylidæ of the group Paracosomus. W. A. Scientist, vii, 219.

Coquillett, D. W.—Revision of the Bombylid genus Epacmus (Leptochilus). Can. Ent., xxiv, 9, 1892.—2 n. sp.

Coquillett, D. W.—New Bombylidæ from California. W. A. Scientist, vii, 197, 1891.

Garman, H.—An undescribed larva from Mammoth Cave. Bull. Essex Inst., xxiii, 136, 1891.—Near Sciara.

Kellicott, D. S.—Note on the horn fly in Ohio. Insect Life, iv, 35, 1891. 22 Rep. Ent. Soc. Ontario, 59, 1891.

Lintner, J. A.—The pear midge (*Diplosis pyrivora*) in New York. Can. Ent., xxiii, 223, 1891.

Smith, J. B.—Notes on blackberry borers and gall makers. Insect Life, iv, 27, 1891.—Cecidomyid.

Smith, J. B.—Habits of *Volucella fasciator*. Can. Ent., xxiii, 242, 1891.

Snow, W. A.—The moose-fly—a new Hæmatobia. 22 Rep. Ent. Soc. Ontario, 96, 1891.

Townsend, C. H. T.—Notes on North American Tachinidæ with descriptions of new genera and species.—Paper V. Can. Ent., xxiv, p. 64, 1892.—8 n. sp.

Townsend, C. H. T.—A Tachinid bred from a chrysalis. Can. Ent., xxiii, 206, 1891.—*Meigenia websterii* nov.

Townsend, C. H. T.—Notes on North American Tachinidæ, with descriptions of new genera and species.—Paper V. Can. Entom. xxiv, p. 76, 1892.—Clistomorpha, n. g.

Townsend, C. H. T.—Description of a Muscid bred from swine dung, with notes on two Muscid genera. Can. Ent., xxiii, 152, 1891. —Lists of Cordylura and Cleigastra.

Weed, H. E.—The natural habitat of the screw-worm. Can. Ent., xxiii, 243, 1891.

THE

AMERICAN NATURALIST

VOL. XXVII. February, 1893. 314

JOINT FORMATION AMONG THE INVERTEBRATA.

BY BENJAMIN SHARP.

The following observations were prompted by a discussion on the subject of joints, at a meeting of the Academy of Natural Sciences of Philadelphia held on November 22nd, 1892, when Prof. Cope considered some facts relating to his theory of joint formation as seen among the vertebrata.

As his theory has been known for some time, and an extended consideration of it has recently been published[1] I merely quote as a thesis, a sentence published in 1878[2]; "change of structure is seen to take place in accordance with the mechanical effect of three forms of motion, viz, by *friction*, *pressure* and *strain.*"

It occurred to me that if his theory had a general application, some additional proofs could be shown to exist among the invertebrates, where we have the action of muscular force upon hard and resisting parts of the skeleton. Those which present the best study for this purpose, appear to be the crustaceans, where we find an immense variety of articulations in the body and in the limbs; highly complicated locked joints, others allowing motion in but one plane, as well as loose joints, where the hard parts scarcely come in contact with one another, and cases of degeneration of the hard parts, leading to total disappearance of a previously existing joint.

---

[1] The Mechanical Causes of the development of the Hard Parts of the Mammalia, by E. D. Cope. Jour. of Morph. Vol. III, 1889, p. 137-290.

[2] The relation of animal motion to animal evolution, by E. D. Cope, American Naturalist, Vol. XII. 1878, p. 44.

In the annelides, from which, there is no doubt, the arthropod branch sprang, we find no deposit of inorganic salts in the epidermis. (I do not regard the hard, calcareous, and other secretions of tubicolous annelides as entering into this question, as they are merely protective coverings, not acted upon by the muscles of the body, nor is there even any muscular connection with it.) The outer layer of the body is generally of a horn-like character, adhering closely to the secretive cells of the epidermis, very flexible and thrown into folds by the vermicular motion of its possessor. In the leeches, the body consists of a flexible cylinder, made up of two sets of muscles, an outer longitudinal cylinder and an inner cylinder of circular fibers, the contraction of which, causes the animal to increase in length, while shortening is effected by the contraction of the longitudinal layer. The external surface of the medicinal leech, for example (see fig. 1) is thrown into a regular series of very fine folds, extending across the longitudinal axis of the body. These folds do not correspond in numbers, to the somites of the body, which are not indicated externally, five, six or more of them belonging to one somite. When the animal shortens its length, these folds are deepened and the segments thrown closely together; when extension takes place, the folds are flattened, spread open, although not wholly disappearing, as they are a fixed quantity so to speak. I believe these folds are due to mechanical action: by the disposition of the different fibers of the longitudinal series, in being inserted in a series of planes bounded by the

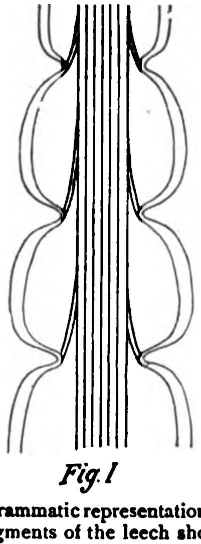


Fig. 1

Diagrammatic representation of the segments of the leech showing the folds, valleys and muscular fibers.

valleys between the folds, this being aided by some of the circular fibers which pass through the longitudinal sheath, and find their attachment to the bases of the valleys.

Starting from this point, and supposing the regularity of the folds to have become established from pre-existing irregular folds by the regularity and stress of muscular action, we can conceive that when deposits of calcareous matter took place, rings similarly formed by a folding of a soft skin would receive that deposit at the most prominent portion of this fold, the convex face and not in the protected valleys, as there would be more friction or pressure from external causes, and no deposits would take place in the valleys themselves because they would not be subject to external friction, and their continual flexion would prevent any such deposits. Should such a deposit take place in the valleys, there would be a stiffening of the whole surface which would defeat motion. In fact, in the leech, the cuticle is already much thicker on the crests of the folds than in the valleys.

In the more primitive crustacea, we find the animal made up of rings extending over the whole length of the body, similar to the rings of the leech, save (fig. 2) that there is but one ring to one somite, and instead of a perpendicular valley between the folds, this valley has an inward and a forward direction, allowing the anterior edge of a caudad ring to fit into the posterior edge of a cephalad ring.

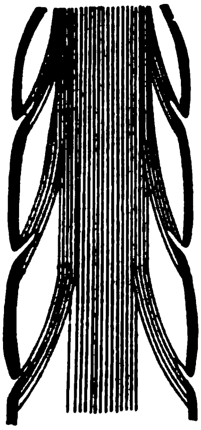


Fig 2

Diagrammatic representation of the rings of a primitive crustacea showing the action of the muscles.

In the higher crustacea, several of the anterior rings have coalesced, and form a solid shield which is known as the carapace. This has no doubt arisen by the lessening of the action between the anterior rings when the posterior portion of the body became the more active propelling organ. As the action ceased forward the valleys came to rest, and became exposed to friction and pressure, and consequently a deposit of calcareous matter took place producing the stiffening above hinted at.

The formation of jointed appendages from parapodic paddles of the annelides can be followed out in the same manner, since the manner of mutual relation of the segments is the same as in the case of the body segments.

It has been stated that in the leech the folds do not correspond in number to the somites of the body, while they do in the crustacea. All annelides do not move by means of a muscular system built upon the plan found in the leech. In many the circular layer has to a large extent disappeared, for the longitudino-circular plan is undoubtedly ante-annelidan. The movement of the free medusoid forms, and of the Ctenophora, is the result of a modified arrangement of this plan.

With the disappearance of the circular layer, we find a peculiar modification of the longitudinal layer. This layer becomes broken up and the fibers act in moving the setæ, which answer to limbs. In a segment of a setiferous annelid, we may observe that the longitudinal muscles of the somite in section at the position of the seta are arranged like the letter "V," in the fork of which the seta lies, the fibers to the left (anterior) pull the seta externally backward, those on the right (posterior) pull the seta forward. The introduction of the setæ, the origin of which I do not here attempt to explain has no doubt been, together with the establishment of external segmentation, a strong factor in causing the breaking up of the muscular tube into sections (myotomes), which by use and consequent increase have extended each arm of the "V" into the segment on each side, while the insertion of the end of the seta has caused a break in the muscle by the formation of an aponurosis. This gives us the peculiar disposition of a myotome to extend arcoss the union of two somites.

If we examine the segments of the so-called abdomen of the macrurous crustacea, as the lobster, we will find that the anterior face of one abdominal ring is pulled into the posterior orifice of the ring lying anterior to it, forming a kind of tubular ball and socket joint, but with a flexible part of the integument with no calcareous deposit, folded upon itself, and acting physiologically as a tubular *ligamentum teres.* On examining the different joints, we will find that commencing at a fixed point, as at the base of the thorax, the movable ring of the first abdominal somite is *pulled into* the fixed part. Then the first abdominal somite becomes the fixed point for the movable ring posterior to it, and so on, so that we find that the rings proceed away from the thorax, each is pulled into the opening of the one in advance. This is true of all those forms where the abdomen is well formed, strong and an active organ in the economy of the animal; when this organ, the abdomen, ceases to be an active organ of motion as in the burrowing forms, as *Callianassa, Gebia,* some of the *Squillidæ,* etc., or where it is folded upon the sternum of the thoracic region, the muscles becoming weaker through disuse, the rings are not subject to the powerful muscular strain, and they as a rule overlap but little if at all, but lie so that the edge of one ring rests upon the edge of another. In those forms where degeneration of the abdomen has proceeded so far as not to have even the usual deposit of calcareous matter, as in the hermit crabs, there are simply indications of rings on the abdomen, and this organ is but little more than a fleshy sac containing some of the viscera, and supplied with a few muscles which act together, with the form of the organ, to keep the abdomen curled so that it may hold as a hook, the animal within the molluscan shell which it habitually occupies.

In forms as highly developed as the cray-fish and the lobster where the calcareous deposits are great, there have crept in many modifications. One of the main features in the articulations of the rings of the abdomen is the "lock" or hinge which allows no lateral movement in the tail whatever; the lateral movement is also prevented by the overlap of the pleura. This lock consists of a rounded prominence on each of the rings projecting *forward* from a posterior segment into a socket in the anterior one. The movement in any two segments so formed takes place in the plane, the axis of which passes through these two points so that the arc described by the movement is only in a vertical plane. The terga of the segment is much arched in the lobster, and the upward motion is limited after a certain point is reached by the dome of the segment itself. In some of the *Scyllaridæ,* there is a transverse groove on the terga of the somites merely indicated in the lobster, into which the posterior face of the terga ahead of it fits when the abdomen is fully extended, and which prevents any further upward movement. It will be noticed further, in those forms that the sternum of each abdominal segment is very narrow, and that they are connected by a broad uncalcified membranous area which allows plenty of room for flexion downward.

The first abdominal segment is narrow, and in the vast majority of cases it is *considerably* narrower than the one which follows it so that it may be covered by the posterior edge of the carapace and the anterior edge of the second abdominal ring. In the *Homaridea* and *Loricata* there is an interesting provision to prevent the strain of the powerful abdominal muscles from drawing the smaller segment too far into the thorax. On each of the lateral faces of the ring there is a broad tooth or calcified lobe, which overlaps the posterior edge of the carapace allowing the latter to play between it and the surface of the ring.

When the limbs are examined, the same rule will be found to hold good viz.: that the movable part is pulled into the fixed part. A modification of this is well illustrated in the evolution of the large chelæ. In some forms, take for example *Ibacus,* the first pair, and in fact all of the thoracic limbs end in a sharp pointed segment, there being not the slightest suggestion of a chela. In *Crangon,* (fig. 3) on the other hand, the ternimal segment is pulled against the broad face of the penultimate one thus making a shift for a chela. In the Stomatopoda this step has been developed, for the last segment can be drawn against the whole length of the penultimate one (which is sometimes grooved to protect the points of the spines of the latter,) and forms with it a very effective grasping organ. The continual use of the terminal segment, the increase of the muscular power

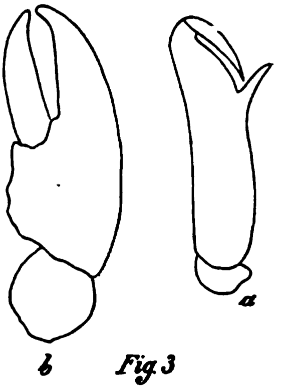


Fig 3

a. "hand" of a form of Crangon.
b. "hand" of a form of Astacus.

will tend to draw this terminal segment backward (into) on the penultimate which enlarges with the increase of bulk of muscle, so that a well developed chelæ, as in the lobster, is found where the ultimate segment is pulled backward to about the middle of the penultimate segment.

A true ball and socket joint rarely if ever obtains in the crustacea, and for very obvious reasons. The nature of the impassive connection of the joints would not allow of the motion and the active element, the muscle acts upon the *inside* of the joint or through its center, thus making it almost impossible for muscles to act so as to give the free movement of a ball and socket joint. The same end is obtained by a series of ginglymoid joints working in different planes so that in a series of three or four joints the end of the limb, for example, can be made to describe a circle, and I am inclined to believe that in order to obtain this free motion, the first two or three joints of crustacean limbs are as a rule very short and work in different planes.

Several objections may be easily found to the statement that posterior segments are always drawn into the anterior ones. Take for example, the shrimps, where the *second* abdominal ring *overlaps* the first so that the ring ahead of it as well as the others behind it is drawn within its anterior opening. I am inclined to regard this exception as more or less proving the rule, and to consider the second segment the fixed point into which the other two rings are drawn. We see a foreshadowing of this plan in the lobster group, where, as in *Astacus*, to use the words of Huxley, "the pluræ of the second somite are much larger than any of the others, and their front edges overlap the small pleuræ of the first abdominal somite, and when the abdomen is much flexed these pluræ even ride over the posterior edges of the branchiostegites."[3]

An exception much more difficult to explain is that found in some of the anomurous forms as *Galathea*, where the fourth, fifth, sixth and seventh segments follow the rule, and the first

---

[3] The Crayfish, an introduction to the study of zoology, by T. H. Huxley, New York and London, 1880, p. 98 and 99.

in regard to its anterior face, but the second overlaps the first, the third, the second, and the fourth. In other words, the fourth has pulled both ways as the second has in the shrimps, but in the latter the second segment is obviously the largest of the series, while the abdominal segments of *Galathea* are all of about the same size and strength.

We may, however, provisionally accept as a natural consequence and general rule, that the motion of a movable part naturally hollows out for itself a cavity in which to move within the solid and fixed basis. This may be further illustrated in the hard parts of the vertebrata.

It is a well known fact that even when the muscles are said to be at rest, there is more or less of a strain, or pull exerted. When the human hand hangs loosely down, it rests half way between extreme flexion and extreme extension; the same may be said of the fingers, although in some persons, as in sailors, where the flexor muscles are very strong the fingers hang as so many " hooks, " owing to the pull of the more powerful flexor muscles. This is well shown in cases of the paralysis of one set of muscles; the parts are drawn to the side of the healthy muscles even when no voluntary action is exerted by the normal muscles. This is too well known to medical men to require further comment, and is especially illustrated in cases of facial paralysis where the face is drawn strongly to one side by the normal muscles.

Taking the action of the normal muscles when at so-called rest, it is not surprising to find that in the joints the lighter or more mobile part, being continually pulled against the fixed part and moved upon it, that a cavity should be formed in the fixed parts by the continual action and pressure of the mobile part. Take for example, the humerus in man, the head is hemispherical and fits into a concave portion of the scapula, a true ball and socket joint, and it is formed, if there be any truth in the idea, by the humerus being pulled into the scapula by the powerful muscles of the shoulder. And as this is probably the first joint which was formed in the evolution of the limb which then acted as a fin, the rotatory motion aided and finally established the ball and socket form of joint. Other cases might be mentioned as that of the lower jaw and the tarso-tibial joint.

In the above remarks, I have simply made an attempt to apply the theory of mechanical genesis to a much neglected group of the invertebrata, and if I, in this, have only been able to direct attention to the field of carcinology, I will feel that this short paper will have served its purpose.

THE GASES IN LIVING PLANTS.

(*Continued from Vol. XXVII, page 7.*)

By J. C. Arthur.

Kinds of Gases and Relative Amounts.

It is now our duty to give a brief statement of the kinds, the source and the movements of gases in plants.

Plants are permeated by the same gases that make up the atmosphere surrounding them: oxygen, carbon dioxide and nitrogen. Nitrogen in the form of a gas is neither used nor generated by any part of plants, unless we except the tubercles of certain roots, and so it occurs in about the same percentage inside the plant as outside of it. On the other hand, both oxygen and carbon dioxide enter into combination with, and are liberated from, the plant tissues in varying amounts at different times. The percentage of these two gases in the cavities of the plant vary through a considerable range. In a series of determinations made by Lawes, Gilbert and Pugh, in England, the oxygen ranged from 3 to 10 per cent., and the carbon dioxide from 14 to 21 per cent in plants which had been for some time in the dark, while plants which had been standing in sunlight reversed these figures, and gave 24 to 27 per cent. of oxygen and 3 to 6 per cent. of carbon dioxide. The two gases, therefore, bear a somewhat reciprocal relation, their sum usually being about 25 to 30 per cent. of the total gas in the plant.

Variation in Amount due to Assimilation.

The variations in the relative amount of oxygen and carbon dioxide are due to two independent processes incident to the life of plants. One of these processes is assimilation, by which all green cells of plants in the presence of sunlight, or its equivalent, such as a strong electric light, absorb carbon dioxide and liberate oxygen. This process goes on with great rapidity in healthy cells, but is entirely checked upon the withdrawal of light, or when it reaches a certain low intensity. Of course it never takes place in roots, flowers, the central portion of large stems, or other parts which are not green, nor in any fungi or other plants not possessed of green coloring matter.

VARIATION IN AMOUNT DUE TO RESPIRATION.

The other great cause of disturbance in the relation of oxygen and carbon dioxide in the plant, is the process of respiration.

Respiration in plants is essentially the same as in animals, and consists in the fixation of oxygen and the liberation of carbon dioxide. It takes place in every living cell, whatever the kind of plant, whatever the part of the plant, and whatever the conditions of active existence. The rate of respiration varies with the temperature, the age of the cell, and the nature of the chemical transformations. In normal respiration the amount of oxygen absorbed is approximately the same as the amount of carbon dioxide evolved. There are, however, certain modified forms of respiration in which this does not hold true.

If living plants be placed in a vacuum, or in an atmosphere deprived of oxygen, it is found that they can still carry on life processes for some time, accompanied with an evolution of carbon dioxide. The oxygen necessary for this process is obtained from the breaking up of compounds in the cells, and it is therefore called intramolecular breathing.

The germination of seeds, which contain a large amount of oil, is somewhat the opposite of this last process. In order to convert the fat into a more directly servicable food material for the plant, a large amount of oxygen enters into the new combination, for which there is no equivalent amount of gas liberated. It consequently comes about that oily seeds in germinating absorb a far larger amount of oxygen than they liberate of carbon dioxide. This is known as vincular breathing.

Another variation from normal respiration is known as insolar breathing, and which, with still some other modifications, I need not stop to explain. To this brief statement of plant respiration must be added that much yet remains to be discovered regarding the details of the processes.

Assimilation and respiration are the two great causes which disturb the relative volume of the two variable gases in plants.

MOVEMENT OF THE SAME TWO GASES.

We shall now turn to the movement of the same two gases, oxygen and carbon dioxide. There has never been a disposition, as in the case of many other plant phenomena, to explain the movement of gases upon any other than purely physical principles. We have therefore to do simply with the question of the aids and hindrances to the establishment of an equilibrium between the gases inside and outside the plant, irrespective of whether the cells are alive or dead.

OUTER AND INNER PRESSURE OF GASES.

It has already been stated that the relative amounts of oxygen and carbon dioxide inside the plant are usually very different, and that within a few hours the relation of the two may be completely reversed. To this may be added that the pressure of the gases inside the plant is sometimes more, sometimes less than that of the atmosphere outside the plant, almost never the same. Hales observed in his early work that a mercury guage connected with the inside of the trunk of a tree showed an internal pressure when the hot rays of the sun warmed the trunk. This was largely due, undoubtedly, to the expansion of the gases in the trunk, by the heat. Such an excess of pressure in water plants is very common, although due to other causes. It may readily be shown by breaking stems under water, when bubbles of gas will be liberated, as undoubtedly many have noticed in gathering water lilies, or other water plants.

On the other hand, the pressure of the gas inside the plant may be less than on the outside. This has long been recognized, but was best demonstrated by von Höhnel in 1879, to whom it occurred to cut off stems under mercury. In doing so the mercury rose to a considerable height in the vessels of the stem, and as mercury is without capillarity, this can only be ascribed to the greater pressure of the outside air, or in other words, to a partial vacuum in the plant.

An observation was made by Hales, whom I have mentioned so often, which we may use to illustrate how such a negative pressure, as it has been called, can be brought about. He cut off a branch, fastened an empty tube to the cut end, and plunged the other end of the tube into a liquid. He found that as evaporation of moisture from the leaves took place, the liquid was drawn up into the empty tube. This phenomenon can now be explained more satisfactorily than could be done at that early day. By evaporation the liquid water inside the plant escapes in the form of vapor, and the space it occupied is filled by the gases, thus rarifying them. This rarifaction may go on in uninjured plants until the internal pressure is greatly reduced. But in the experiment, the pressure is equalized by the rise of the liquid in the tube. A later modification of Hales' experiment is to use a forked branch, place the cut end in water to give a continuous supply of moisture for transpiration, and attach the empty tube to one of the side forks of the stem, cut away for that purpose.

PERMEABILITY OF TISSUES.

It is self-evident that such condensation and rarifaction of the gases in the plant could not take place if the cell walls were readily permeable to gases. Thus it comes about that one of the most important topics in connection with the movement of gases in the plant, is the permeability of tissue walls of various kinds, and especially those constituting the surface covering of plants.

I shall not attempt to conduct you through the tangle of supposition and fact, errors in experiments, correct and incorrect conclusions, and the general confusion which has come from the labors of physicists, chemists and botanists for the last twenty-five years, during which the subject has received particular attention. The results of the later work have been to cast grave doubts upon the correctness, or at least the interpretation of some of the experiments most relied upon heretofore. Nevertheless many points still lie open for verification, and untouched parts of the subject await investigation.

MOVEMENT THROUGH SURFACE OPENINGS.

In the earlier days it was found that the leaves and young stems of plants have their epidermis more or less well supplied with minute openings, called stomata, or breathing pores, which communicate with small air cavities inside, which in turn branch out among the cells into a net work of minute passages rarifying throughout the plant. This intricate net work of intercellular passages affords an air communication throughout the whole plant, and connects directly with the outside atmosphere through the stomata. Subsequent to the discovery of stomata, it was ascertained, that in stems more than one year old, the stomata are replaced by another kind of opening, known as lenticels, which in some form are doubtless to be found in the bark of shrubs and trees of whatever age.

Gases stream into and out of the plant through the stomata and simpler lenticels, according to the law governing the movement of gases through minute openings in thin plates. The rate of movement is accordingly proportional to the square roots of the density of the mixing gases. Such a movement of gases is known as effusion.

MOVEMENT THROUGH INTERNAL PASSAGES.

The movement by which gases pass from one part of the plant to another, through the intercellular spaces, is governed by other laws. It was at first thought that the rate of movement would correspond to that in capillary tubes, according to the well known law of Poisenille, that it is proportional to the fourth power of the diameter, divided by the length of the tube. But upon testing the matter two years ago, Wiesner found that owing to the extreme minuteness of the intercellular spaces, and their zigzagged and branched condition, this law does not hold, neither does the movement prove to be proportional to the density of the gases. The discovery of the law of the rate of movement of gases in intercellular spaces, that is, the transpiration of gases, is, therefore, yet to be discovered, together with other interesting facts pertaining to the subject. Poisenille's law does, however, hold good for the movement of gases in the woody ducts, but here it is of limited application, for these do not connect with one another, with the intercellular spaces, or with the exterior of the plant.

MOVEMENT THROUGH CELL WALLS.

The walls of most cells, ducts, and surface covering of plants, except as already mentioned, are imperforate, that is without any openings that can be demonstrated by the microscope. If gases pass through them, it must be in accordance with some law of diffusion, or osmosis. Many experiments in this line have been tried, and the results have been of the most diverse character. It is impossible to give a fair idea of the subject in the time at my disposal, and it must suffice to mention a few bare facts.

The most astonishing and important results were obtained by Wiesner, in experiments conducted at Vienna, two years since. It would be a most natural interpretation, it seems to me, to think that the gases are forced from one cell to another, through the cell walls by differences in pressure. Wiesner found, however, that it is impossible to force gases through cell walls of any kind whatever, by any pressure they will stand, acting for any length of time. For instance, a bit of grape skin held up a column of mercury, 70 centimeters high, for 75 days, and a piece of cherry skin withstood a pressure of 3 atmospheres for 24 hours. Similar experiments were tried with cuticularized, suberized, liquified and simple cellulose tissues from many sources, and with uniformly the same results, whether the tissues were moist or dry, alive or dead.

But in the same set of experiments it was found that if gases cannot be forced through cell walls, they will readily pass through by simple osmotic diffusion. All cells permit the passage of gases by diffusion when moist, dependent upon the coefficient of absorption and the density of the gas. Cuticular and corky formations also permit the passage of gases when dry. Thus we see, that gases may be forced through the stomata, or breathing pores, by varying pressure, but can only pass through the epidermis and bark of plants by diffusion. We therefore arrive at the conclusion that the gases inside and outside of the plant are brought to an equilibrium by direct interchange through the stomata and intercellular spaces, aided by the comparatively slow process of diffusion through the whole surface of the plant, both above and below ground.

IN CONCLUSION.

After so long a discussion of the subject of the origin, kinds and movement of gases in plants, I trust I have not only brought out the main facts regarding our present knowledge, but also made evident some of the numerous directions in which further experiment and research is needed. It would be most appropriate to transfer the activity in this subject to the laboratories of this country, and let the Americans take up the line of discoveries carried on so far by the English, French, and lastly, the German scientists.

LEGENDS OF THE SUMIRO-ACCADIANS OF CHALDEA.

BY ALICE BODINGTON.

(*Continued from Vol. XXVII, p.* 19.)

In Genesis, as is well known, two distinct accounts exist of the creation of the world and of Man, of which variants are found in the cuneiform inscriptions. One of these variants, lately found on a tablet of baked clay, with a parallel Semitic translation, is of great interest. It begins at an earlier period of cosmic history than either the Biblical or the hitherto known Chaldean account.[1] Whilst the version of the first chapter of Genesis[2] begins with a description of chaos and the old Semitic Babylonian version with the time "when the heavens were not proclaimed and the earth recorded not a name," the Sumiro-Accadian account begins with a description of the time when the "glorious house of the gods (apparently the sky,) had not been made, a plant had not been brought forth nor a tree created; when a brick had not been laid, a beam not shaped, a house not built, a city not constructed and a glorious foundation or dwelling of men had not been made." But when "within the sea there was a stream," then "the glorious city of the gods, the divine Eridhu," was built, of which Babylon, the earthly Eridhu, was a faint copy. Then the tablet mentions the creation of living beings, not men as yet, but gods and the spirits "Anunnaki"; and the supreme deity proclaims the existence of the "glorious city, the seat of the joy of their hearts." Meridug, son of Ea, now "made a foundation before the waters"; made dust and poured it out with the blood, and in one single line "he made mankind." The female principle, the goddess Araru, (the Bohu of Chaldean legend the Bohu of Genesis 1.2) "made the seed of mankind with him."

---

[1] That deciphered by George Smith.

[2] New Version of the Creation Story. Paper read by Mr. T. G. Pinches, of the British Museum, at the International Oriental Congress.

Then he made the beasts of the field and the living creatures of the desert; the Tigris and the Euphrates, and "proclaimed their name well," in fact said that creation was good, as in Genesis. Then Herodach created grass, the plants of the marshes and the forests; and with the plains and forests in which they were to dwell, he made oxen and other large cattle and sheep. This deeply interesting account has been necessarily much abbreviated.

The Accadian idea of the structure of the world must be understood before the various legends as to the creation and the early history of mankind become "thinkable" to the modern mind. In our mind's eye we see the world as a comparatively insignificant planet whirling at headlong speed round a central sun; we know the blue sky to be only the effect of distant air; it is not "thinkable" to us that the sun should stand still at the bidding of the leader of a small tribe of half savage Nomads, nor that a tower should be built to attain a solid sky, above which lived gods, alarmed and jealous at so daring a proceeding. Nor can we picture to ourselves a great reservoir or "Heavenly Ocean" above a solid sky, which could be "opened" to let the waters submerge a sinful world. But all these stories are in harmony with Accadian cosmogony. The Chaldeans imagined the earth as an inverted boat or bowl, the thickness of which would represent what we call the crust of the earth; while in the hollow beneath this crust lay the "abyss," the abode of many powers, and answering to the Elysium and Tartarus of classic mythology. Here dwelt Allat, the remorseless Queen of the Dead; from the Abyss issued the terrible Maskim, the seven evil spirits, who knew neither mercy nor pity.[3] Here too was Eridhu, the "glorious abode," within which was the tower which reached the skies.

Above the convex surface of the earth spread the sky, (*ana*) divided into two regions, the highest heaven or firmament, which with the fixed stars immovably attached to it, revolved as upon an axis, round an immensely high mountain, which joined it to the earth as a pillar. In the lower heaven the planets conceived of as resplendent animals of beneficent nature, wandered forever on their appointed paths. The earthly ocean, a counterpart of the heavenly ocean, was imagined as a broad river, or watery rim, flowing all round the edge of the inverted bowl, precisely as Herodotus described it. And so late as the Middle Ages, we find Dante's conception of the structure of the world to be substantially that of the Accadians; the "purgatorio" is an immensely high mountain joining earth and sky, through whose circles pass the souls in a state of probation, till at the top they step into the lower heaven.

---

[3] Chaldea, pp. 153–157.

In the fine Accadian epic of which the account of the Deluge furnishes the eleventh book, the ark is represented as resting on this mountain. It relates[4] that Tzdubar, the national hero, was beloved by the goddess Tshtar. She promised him a "chariot of gold and precious stones; that kings and princes should bow before him, and kiss his feet; that his flocks and herds should multiply two fold, and his mules and oxen be peerless of their kind." But Tzdubar laughed her love to scorn, and the enraged goddess implored her father, Anu, to take vengeance on him. A monstrous bull was sent against his city of Erech, but it was slain by Tzdubar's friend, Eâbani, and laid before the altar of the god Shamash, whilst the people spent the night in feasting and rejoicing. But the vengeance of Tshtar was not to be so easily foiled. With the help of her mother she smote Eâbani with sudden death and Tzdubar with a dire disease, which made life a burden. He determined in his anguish to seek relief from his great ancestor, Hâsisadra, who dwelt, immortal, in the Blessed Land, at the "mouth of the rivers" beyond the Waters of Death. Long and weary was the journey, and on his way Tzdubar passed the giant warders of the sun—half men and half scorpions—who kept watch over his rising and his setting. On the shore of the Waters of Death the hero met the ferryman Urubél, and for a month and fifteen days they journeyed together over that dreary sea, till they reached the Chaldean "Valley of Avilon," and Tzdubar met his ancestor face to face. Here Hâsisadra related to his descendant the story of the Deluge, and his own

[4] Chaldea, pp. 301–17.

share in that great event. Tzdubar was purified and healed by laving in the Waters of Death; he returned safely to Erech, and there offered up a touching prayer to the beneficent god, Ea, that his lost friend, Eâbani, might be restored to life. Ea, through his son, Meridug, brings Eâbani from the world of Shades to the Land of the Blessed, there to live forever among the heroes of old, and so all ends happily as a fairy tale.

The Chaldean legend of the Deluge is, as is well known, an extremely close variant of the account found in Genesis, even to the rainbow as a sign of the repentance of the God Anu, for the havoc he had wrought. Only it is Tshtar who "spreads out the great bows of her father Anu," and who says "I shall be mindful of these days; never shall I lose the memory of them," and the assurance is given that though pestilence and wild beasts may be sent as a punishment for the wickedness of man, never shall a universal flood again overwhelm the earth. In the Chaldean account it is the ever beneficent Ea who warns Hâsisadra of the coming flood, and bids him prepare the ark for himself and his family, and who himself sends the cattle and the wild beasts of the field to their haven of safety; he who reproaches the other gods with the wanton destruction they have wrought, and brought Bel, hasty but quickly repentant to his senses. Bel himself took Hâsisadra by the hand and led him out of the ark, after the sacrifice had been offered up, "when the gods smelled a sweet savour." See Genesis viii, 21.

The great solar and catholic myths are found in their earliest forms amongst the Sumiro-Accadians, and from them they passed through the Phœnicians to the Greeks and Romans. Tshtar, the great goddess of Nature, personifying the life-producing earth, loves the young Sun-God, Dumuzi. The tablet of the national Epic, which describes the manner of his death, has unfortunately but one fragment left, which speaks of the "black pine of Eridhu, marking the centre of the earth, in the dark forest, into the heart whereof man has not penetrated; within it Dumuzi. . . ." A month was set apart, (June–July), both in Chaldea and Assyria, as mourning for the death of Dumuzi, however it occurred; the mourners wept and wailed, and tore their hair for the first six days, and at the close of the sixth day the wildest and most extravagant rejoicing marked his resurrection and restoration to Tshtar. Six hundred years B. C., Ezekiel, in captivity at Babylon, speaks of the "women weeping for Tammuz," (Dumuzi). We have, fortunately, the tablet, nearly complete, which relates Tshtar's descent to "the land whence there is no return, towards the dwelling that has an entrance but no exit, towards the hall from which the light of day is shut out, where the shades of the dead dwell in the dark." Tshtar haughtily orders the warder to open the gate, "If thou openest not, I will demolish the threshold. . . . I will let loose the dead to return to earth. . . . I will make the risen dead more monstrous than the living." The gatekeeper humbly answers the angry goddess: "Be appeased, O Lady, let me go and report thy name to Allat, the Queen." And Tshtar declares that she comes only to "weep over the heroes who have lost their wives; over the wives who have been taken from their husbands' arms. I wish to weep over the Only Son, (a name of Dumuzi,) who has been taken away before his time." Allat, full of evil delight that a hated rival has come within her power, orders the keeper to open the seven-fold gates for Tshtar, with the stipulation that at every gate she should strip off some of her attire. The warder of Arallu takes from the goddess her earrings, her necklace, her jewelled girdle, the bracelets on her arms, and the bangles at her ankles, and lastly her long flowing garment, and with these her divine power departed, and she stood powerless before the spiteful Queen of the Dead. Allat orders her chief minister, Namtar, the Pestilence, to lead Tshtar away, and to afflict her with sixty dire diseases, in the deepest darkness of the abyss. Meanwhile, as when Demeter mourned inconsolably for her lost Persephone, all went ill in the upper world. Life and love had gone out of it; there were no marriages and no births, and the gods held council as to the release of Tshtar. The beneficent Ea conceived a plan. He created a phantom, Uddusunamir. "Go," he said, "to the Land whence there is no return, and the seven gates of Arallu will open before thee. . . . Conjure Allat with the name of the great gods; stiffen thy neck and keep thy mind on the Spring of Life. Let the Lady (Tshtar) gain access to the Spring of Life, and drink of its waters." Allat in her fury beat her breast and bit her fingers with rage. She ordered Namtar to let Tshtar drink of the Spring of Life, and bear her from her sight. Namtar took the goddess through the seven enclosures, restoring at each the article of her attire that had been taken from her. At the last gate he said: "Thou hast paid no ransom to Allat for thy deliverance; so now return to Dumuzi, the lover of thy youth; sprinkle over him the sacred waters, clothe him in splendid garments, adorn him with gems." The last lines of the poem are mutilated, but it is evident that they bear on the reunion of Tshtar with her young lover.

Not only does this myth remind one of the legends of Demeter and Persephone, of Adonis, of Balder, the beautiful, and of Osiris, but what—if it were possible—seems like a variant of the same myth, is the legend amongst the Tee-Wahn[5] Indians of Nah-chu-ru-chu (the Bluish Light of Dawn) and his lost wife, the Moon-maiden. Nah-chu-ru-chu held the well-being of all his people in his hands for life and death. When the jealous Corn-maidens had thrown his wife down a deep well where none could find her, Nah-chu-ru-chu sat for days, neither speaking nor moving, his head bowed upon his hands. Then no rain fell and the crops died, and thirsty animals wandered, crying along the dry rivers. The coyote, the badger and the eagle went to seek the lost Moon, and when at last she was found, the choked earth drank and was glad and green, the dead crops came to life, and for four days the people danced and sang in the public square.

In innumerable ways have the Accadians been the priests and schoolmasters of mankind in Europe and Asia, for through the Bâk tribes of Elam, in Southern Chaldea, they are considered to have been the founders of the ancient civilization of China; and through the Semitic peoples they have conferred upon us gifts, good and bad; the art of writing, the signs of the zodiac, the measurement of the year, the early legends of Genesis, the keeping sacred of the seventh day, the belief in magic and witchcraft, and the mediæval devil. An Assyrian calendar mentions a day called Sabattu, "a day for completion of work, of rest for the soul." On that day it was not lawful to cook food, to change one's dress, to offer a sacrifice; the king was forbidden to speak in public, to ride in a chariot, or perform any civil or military duty"; a strictness equal to the Sabbatarianism of the most orthodox Jew.

---

[5] Tee-Wahn Folk Stories. St. Nicholas, March, 1892.

On their way to a pure monotheism, the early Jews seem to have combined in their "Elohim," and their "Yahveh," the characteristics of the principal gods of the Sumiro-Accadians. We recognize the features, sometimes of the calm and beneficent Ea, and of his son Meridug, Intercessor for men; sometimes of the hasty, vindictive Sun-god, Bel, who "consumes in a moment" the victims of his anger, till the features of all these Nature gods fade away in the moral effulgence of the sublime God of Isaiah.

No object is commoner in Chaldean and Assyrian pictorial representations than the Sacred Tree, the Tree of Life, with and without the serpent. To the old Chaldeans the Sacred Tree was intimately connected with an original ancestral abode, an earthly Paradise, watered by springs which became great rivers.

The "serpent of Genesis we recognize as Mummu-Tiamat," the "Dragon," the "Great Serpent," who was the sworn enemy of the gods and their creation; the principle of opposition and destruction. The gods determine to fight the great Serpent; Anu, the heaven God, prepares the sickle-shaped sword, and the beautifully bent bow, whilst Bel goes forth in his matchless war-chariot, sending the lightning before him, and scattering his arrows around. Tiamat comes forth to meet him, attended by evil demons, and bearing death and destruction in her train. But it is Meridug, the intercessor for mankind, who "bruises the serpent's head"; who binds her and puts an end to her works, while her followers fly terror-stricken.

I have not space to give a tithe of the profoundly interesting and suggestive facts revealed by the deciphering of the cuneiform inscriptions. We find ourselves looking at the cradle-land of our religion, our sciences and our literature; we find the most touching and passionate appeals to the Divinity in the very spirit of the finest Psalms of David, in a land looked upon as the seat of the grossest idolatry; we find a civilization old enough to have been the parent stock of the civilization of China; we look upon an early world, which knew nothing of the proud white race which now girdles the earth with empire.

Amidst the surging waves which have carried away so many beliefs, we find two anchors linking us to the Unseen, which become the firmer the more we know of evolutionary processes. One is the enormous strength of the religious instinct, even at the earliest stages of the civilization of mankind. And if the study of evolution teaches us one thing more than another, it is that *no instinct exists in vain.* The other foreign to my present subject is the inscrutable nature of the "*noumenon,*" which lies behind all phenomena; that Energy, which, whether we think of it as "gods" with the old Accadians, as the "Supreme Being," or by whatever name we strive to approach the Unknown Reality, it remains equally Unknown, (though perhaps not forever Unknowable,) and equally the eternal object of search and worship.

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER FLORIDA, HITHERTO UNEXPLORED.

By Clarence B. Moore.

(*Continued from January Number, 1893.*)

(*Second Paper.*)

West end of ridge on summit, 7x4x7½ feet deep. At a depth of 1 foot 6 inches, an arrow-head with bones of lower edible animals, was found. Two feet down were fragments of turtle shell, and a half a foot lower, a fragment of a bone awl was met with. At 5 feet, 6 inches, from the surface was a well defined fire-place, with bones of the turtle. The shells are almost exclusively *Paludinæ*, with occasional *Unionidæ* and few *Ampullariæ*.

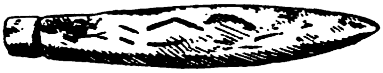
EXCAVATION II.

North-east side of mound about ten feet vertically from the base. Besides the usual fire-places and bones of edible animals, a fragment of a *Fulgur* was found at a depth of four feet.

EXCAVATION III.

On summit near center of ridge, 9x9x11 feet deep. No clearly marked strata were met with, the excavation being carried through shell with a considerable percentage of broken shell and sand. The following objects were found;—flint flake at a depth of 6 inches; fragment of bone awl 1 foot down; small pendant ornament of shell 1½ feet from surface, (Fig. 4)

FIG. 4. Size, ½.



with bone implement; shell gouge (broken) 2 feet down; rude arrow-head on fire-place, 4½ feet down; flint flake 5 feet down; arrow-head lying on fire-place, at a depth of 6½ feet from surface; portion of arrow-head on fire-place, bearing marks of fire at a depth of 8 feet; fragment of bone awl 9 feet 9 inches down; rude bone awl 10 feet down; bones of edible animals, mainly of alligator, deer and turtle, at all depths.

EXCAVATION IV.

At margin of base north-east portion of mound. Trench 11½x10x6 feet deep at end. A piece of coquina, smooth on one side, evidently used for polishing, at a depth of 2½ feet, and a fragment of arrow-head with the usual bones of edible animals, were the only objects of interest met with.

As before stated, absolutely no pottery was seen in the excavation, and this, with the 600 feet of swamp between the mound and the river, would argue for Mt. Taylor a place among the earliest shell heaps of the St. John's. It was the habit of the builders of the shell heaps where solid ground was to be found, to locate their refuse heaps upon it, and it seems unlikely that a spot so far distant from the river's edge as is Mt. Taylor to-day, should have been selected. It is a much more likely hypothesis that the swamp is the result of a change of channel in the river, and has formed since the abandonment of the mound. Professor Wyman has graphically described in his memoir (page 83 et. seq.) the manner of formation of similar swamps. The time required to transform a portion of the river into swamp-land, the writer of this paper believes to be somewhat less than is generally supposed, owing to the great abundance of floating vegetation upon the river. At Little Orange mound, opposite Lake Dexter, is a steam boat wharf in use within eight years, according to the owner of the place. At present, masses of vegetation extending some distance into the river have made access impossible for a boat of any draught, and are speedily forming the nucleus of a future swamp.

Assuming this hypothesis of the formation of the swamp after the completion of the mound to be correct, an indication of minimum age may be obtained in the case of Mt. Taylor through the size of trees growing between it and the water's edge. Between it and the river grow two cypresses, respectively 14 feet in circumference four feet from the ground, and 19 feet, 3 inches, 5 feet from the ground; while a little to the north-west of the mound in the swamp grows a cypress 23½ feet in circumference at a height of 5 feet from the ground. The cypress is a tree of slow growth, by some being placed next to the live oak in this respect.

Another point illustrated by Mt. Taylor is that neighboring shell heaps are by no means of necessity contemporary. In close proximity to it in the river, is Bird's Island,[1] covered with a shell deposit between five and six feet in thickness. Throughout this deposit to the very bottom unornamented pottery is found in great abundance. North of Bird's Island, on the western bank of the river, is the shell bluff described by Professor Wyman (Note A.). This shell bluff, by the absence of pottery and the small size of its *Paludinæ*, differs widely from Bird's Island, and is probably contemporary with Mt. Taylor.

Just what impelled the makers of Mt. Taylor to pile the debris of their meals to such a height and at such an angle it is impossible to surmise. No ridges of shell led to it, while no shell fields surround it, and it is evident that great care was taken looking to its isolation and to give to it its height and shape. In comparison with the shell deposits of Huntoon Island, of Bluffton, of Silver Spring (Lake George), of Tick Island and other localities where the shell deposit, though large, is spread over great areas and not piled at a single spot, the contrast is especially striking.

SHELL DEPOSIT OPPOSITE BLUFFTON.

On the west bank of the river, opposite Bluffton, is a level deposit of shell bordering the water. About fifty yards inland is a small symmetrical mound, not over three feet in height, composed of the same material as the shell deposit, namely shell and powdered shell. An excavation was made in the center of the mound, and within a foot of the surface were found various parts of a skeleton, apparently of a woman. The jaws and all other facial bones were missing, as were one femur, one humerus, both tibiæ and all bones of the feet. Many of the bones had fractures not caused during the excavation, the area of the fracture being of the same color as the remainder of the bone. With the remains were several bits of pottery which seemed to be wanting in the mound, save in association with the bones, and this fact would indicate a burial, as would the symmetrical shape of the mound. The fractures can readily be explained by the proximity to the surface, where the tramping of feet could without difficulty separate and fracture the bones. On the other hand, the absence of so many important bones—for which very careful search was made—would seem to indicate that the entire body was not placed within the mound. The various conflicting facts connected with this case offer one of those questions, unfortunately without solution, which from time to time confront the explorer of the shell heaps.

---

[1] The *Paludinæ* on Bird's Island, it may be remarked, are far larger than any found at Mt. Taylor; well illustrating a point stated in the preceding paper that shell fish of the St. John's had a middle period of increased development, and a subsequent relapse to their earlier condition.

Near this point Mr. Dease, of Volusia, found a small earthenware bowl clinging to the roots of an overturned palmetto, and presented it to the writer.

NOTE A.

AS TO A NATURAL ORIGIN OF ANY OF THE FRESH-WATER SHELL HEAPS OF THE RIVER.

It will be remembered that at the time when Professor Wyman wrote, the agency of man in connection with the shell heaps of the St. John's was nowhere admitted. It is therefore quite natural that taking the initiative in this matter he should have been averse to making any sweeping assertions. There is, however, little room to doubt that all the shell heaps are the work of man. Of the shell bluff near Astor, (Fort Butler) he says[2] (page 38) "taken by itself, in view of the absence of human implements we should hardly feel justified in saying that it was made by man; though in its general features it resembles his work." At the base of this bluff the writer picked up a chisel of shell, and, what is more conclusive (since objects not in place prove but little) a clearly defined fire-place was discovered at a depth of four feet from the surface. It is perfectly safe to say that no fresh-water shell heap can be found on the St. John's River where a careful search would not reveal unmistakable evidences of human agency in its origin.

---

[2] *Op. cit.*

THE ANCYLOPODA, CHALICOTHERIUM AND ARTIONYX.[1]

BY HENRY FAIRFIELD OSBORN.

Chalicotherium was the most unique mammal of the Miocene period. So far as known at present, it combined cheek teeth of a distinctively ungulate type, ankle and wrist joints resembling those of the Perissodactyla, with highly modified phalanges, terminating in large cleft ungues which were undoubtedly covered with strong pointed claws. It was widely distributed over Europe, Asia and North America from the oligocene Phosphorites of France (*C. modicum*) to the early Pliocene of the Siwalik Hills (*C. sivalense*).

The recent discoveries of Filhol and Depéret in France have fully revealed the structure of the skull and limbs, but with the exception of the axis, little or nothing is known of either the vertebræ or scapular and pelvic arches. As we learn from these authors the *Chalicotherium magnum* of Sansan (Middle Miocene) was an animal taller than the grizzly bear. The head was about nineteen inches long and raised five feet above the ground. The limbs were rather slender, and a striking peculiarity of this species is that the fore limb is nearly twice as long as the hind limb (as indicated by the proportions of the radius and tibia). This was not the case in its upper Miocene ally (*Ancyllotherium pentelici*) from Pikermi, in which the limbs were heavy and of the same length. There were three toes upon each foot, but in both manus and pes, the fourth or outer digit was the largest instead of the third or middle digit as in the Perissodactyla. M. Filhol has represented *C. magnum* as fully plantigrade, but this appears to me an error; the perissodactyl displacement of the carpals and tarsals, the structure of the ankle and wrist joints, and the terminal facets of the metapodials all indicate that the feet were sub-digitigrade. Displacement is very rare in plantigrade types. The proximal phalanges are peculiar in having the metapodial facets directed obliquely upward; both these and the median phalanges are short; the distal phalanges are very peculiar, they present a deep terminal cleft and were evidently drawn up or retracted, as in the cats, instead of being drawn down or flexed, as in the Edentates. Thus, it is probable that *Chalicotherium* walked more like a clumsy-footed cat than like the bear. The soles of the feet were slightly turned inward and the fore-limb was adapted to digging or partial prehension.

---

[1] Under the title "The Affinities of *Chalicotherium*," this article was written some months ago. While it was in press, *Artionyx*, a new type of the order was discovered, and at the editor's suggestion, the article was held back to include a description of it.

Restoration. The axial skeleton in the accompanying drawing is mainly based upon Filhol's restoration, but the scapula and pelvis are independently restored upon the perissodactyl model; the sloping trunk leads us to expect a rather broad pelvic basin. All the above parts are purely conjectural.

The proportions of the fore and hind limbs with each other and with the skull are based upon the figures of Depéret. In Filhol's drawing the skull is proportionately too small. The side views of the feet are after Filhol's excellent drawings, but the articular positions are drawn differently, for M. Filhol makes the animal fully plantigrade, while the metapodial and phalangeal and higher articulations prove that it was digitigrade.

What is the explanation of this remarkable assemblage of characters? Where shall we place Chalicotherium, with reference to the two great orders between which it seems to stand midway. If, observing the teeth and the carpus and tarsus, we relate it to Perissodactyla, we find ourselves placing a clawed type among hoofed types. Or is it to be considered an Edentate because of its claws and edentulous premaxillaries as Filhol has suggested? Or is it representative of a distinct order midway between the Ungulata and Unguiculata? It is too early to attempt a final solution of these questions. We must wait for the discovery of the middle and upper Eocene Chalicotheriidæ. It is evident from Gaudry's discovery of the feet in the Phosphorites, *C.* (Schizotherium) *priscum*, that the finding of other Eocene types is not far off. In the meantime I have tentatively offered the suggestion that *Chalicotherium* is

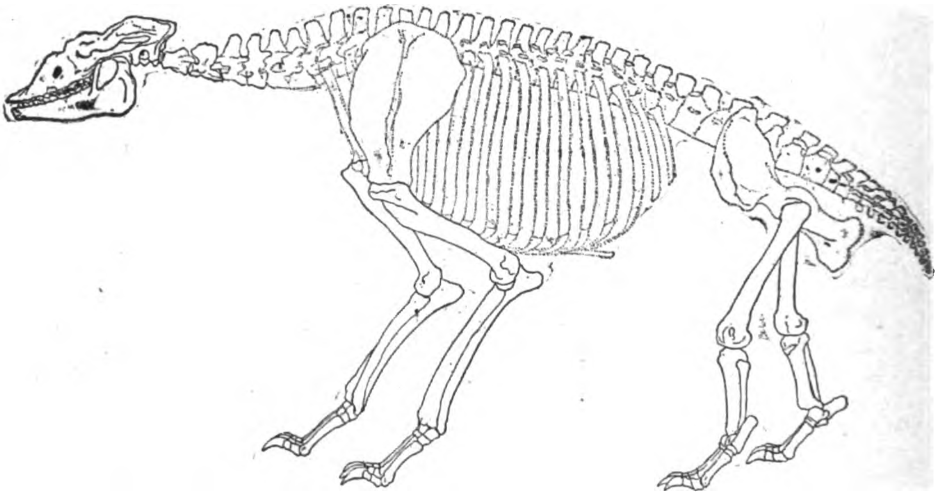


Fig. 1. Restoration of *Chalicotherium*. Modified from Filhol and Depéret.

distantly related to *Meniscotherium* of the lower Eocene (Wasatch), and that this may give us a clue to its zoological position. I will now expand and discuss this idea which may be expressed as follows:

That the group to which Chalicotherium belongs was derived from the Condylarthra of the lowest Eocene, with affinities to the Meniscotheriidae and primitive Perissodactyla. It represents a distinct order, the Ancylopoda (Cope). The likeness to the Unguiculates and especially to the Edentata is due to secondary adaptations and contains no proof of real affinity.

The *history of the discovery* of this animal is as unique as its structure, and illustrates the uncertain path of the vertebrate paleontologist. We are indebted for a full résumé, to Dr. Ch. Depéret, who has fully discussed the bibliography, structure and relations of this genus in his admirable memoir. Until recently the skull and limb bones, wherever found, were placed not only in different genera but in distinct orders. The first remains discovered were the terminal phalanges, found in the upper Miocene of Eppelsheim in 1825; they were sent to Cuvier, who, noting the deep terminal cleft, named them *Pangolin gigantesque.* In 1833 Kaup found in the same beds the isolated upper molars which he naturally attributed to an ungulate, and named *Chalicotherium goldfussi* (syn. *antiquum*). Thus early began the confusion due to the wholly diverse affinities suggested by the phalanges and the teeth. In 1837 Lartet found the feet (in somewhat earlier Miocene beds of Sansan) which he supposed belonged to a huge edentate and termed *Macrotherium giganteum.* In 1853 Lartet also discovered a skull and teeth at Sansan; he was unaware of Kaup's priority and first called the skull *Anoplotherium,* but later separated it as *Anisodon*; Gervais, later, pointed out the priority of Kaup's term. In the upper Miocene of Pikermi Gaudry found feet and limbs quite different from the *Macrotherium* type; these he termed *Ancylotherium.* From the Phosphorites, in 1875, he described the teeth of a new species, *C. modicum,* and the feet of a supposed new genus, *Schizotherium priscum.* The skull and teeth were also found by Falconer in the Siwaliks of India and termed *C. sivalense.*

Considering this exceptional mingling in so many horizons, of one genus represented exclusively by skulls or teeth and another by feet and limbs, Filhol, in 1888, first advanced the conjecture that the two might really be one, and was happily able to confirm this by his own discoveries in Sansan. Forsyth Major independently arrived at the same conclusion from his explorations in the Pikermi beds. Finally, in his memoir, Depéret describes parts of a skeleton and skull found together at Grive St. Alban, in beds nearly contemporaneous with Sansan. In the meantime it is probable that a similar confusion has arisen with us. In 1877 Marsh announced the discovery of phalanges of a large edentate in the middle and upper Miocene of Oregon and Nebraska, and compared them with those of *Ancylotherium* rather than with any true edentates; he distinguished them by the coalescence of the first and second phalanges as *Moropus* (species *distans*, *senex* and *elatus*). The first undoubted remains of *Chalicotherium* in this country were found by Garman in the Loup Fork (upper Miocene) and described by Scott and Osborn. Cope has also described a lower Miocene species (*C. bilobatum*) from the White River beds (Swift Current Creek) of Canada. It is not improbable that *Moropus* belongs to the same types.

Nomenclature and Synonomy. Depéret advocates an important modification in our nomenclature. He believes that the Eppelsheim type, to which the name *Chalicotherium* was originally applied, can be identified by the form of its phalanges with the Pikermi type (*Ancylotherium* Gaudry), and is, therefore, distinct from the Sansan type. For the latter he proposes to retain the name *Macrotherium* Lartet. If this proves to be correct these types should be distinguished as follows:

Middle and Lower Miocene. (Sansan, Grive St. Alban, ? Phosphorites.)	Upper Miocene, Lower Pliocene. (Eppelsheim, Pikermi.)
Macrotherium.	*Chalicotherium.*
Syn.: Anisodon, ? Schizotherium, ? Moropus.	Syn.: Ancylotherium.
Semi-arboreal and fossorial. Light skeleton. Fore-limb greatly elongated. Radius (= .70), tibia (= .29). Radius with large external, and small internal, fossa for humerus. Ulna distinct or very slightly coalesced with radius distally.	Quadrupedal. Heavy skeleton. Fore- and hind-limbs nearly equal. Radius and tibia of nearly same size; of heavy proportions. Radius with subequal external and internal fossæ of humerus. Ulna coalesced with radius.

While many striking differences separated these two types, especially in the proportions of the limbs, the teeth were substantially similar. A strong family relationship is also exhibited in a peculiarity of the feet pointed out by Gaudry, namely, the *proximal* phalanges were retracted and not the distal, while in the cats the *distal* phalanges are retracted and in the edentates the phalanges are not retracted at all but are flexed. In the edentates the foot is thrown upon its outer side; in the Chalicotheriidæ this was only partly the case.

Ungulate affinities of Chalicotherium. M. Filhol's view is that this genus belongs to a group which bridges the gap between the Edentates and Ungulates. When he showed me his newly discovered skeleton in 1889, I was especially struck by the perissodactyl character of the carpus and tarsus, and considered it best to leave the genus in the Perissodactyla as "an aberrant form, with nearest affinities to *Palaeosyops* and genera of that line." It has also been doubtfully placed near the Perissodactyla by Flower and Lydekker.

Depéret has now advanced sufficient evidence to exclude the edentate idea entirely and shows clearly that the resemblances which *Chalicotherium* bears to the sloths are purely superficial. As shown above the adaptations of the phalanges for prehension or digging involve an entirely different set of muscles from those employed in either the Cats or the Edentates. This genus has attained a somewhat similar functional result by a different route—a case of analogy but not of homology. So with the elongation and curvature of the fore-arm, the ultimate coalescence of the ulna and the radius, the backward direction of the olecranon, the cleft ungual phalanges. All these are independent and "parallel" or "homoplastic" adaptations. *Chalicotherium* is still more positively separated from the Edentates by the numerous ungulate characters which it displays.

Depéret is very much impressed by these ungulate structures and places this genus definitely among the Perissodactyla. Let us, therefore, examine the ungulate hypothesis. Upon the affirmative side is the structure of the molar teeth; they certainly bear a distant resemblance to those of *Anoplotherium* and a more striking likeness to those of *Palæosyops* and *Titanotherium.* The reduction of the upper cutting teeth may be regarded as a secondary adaptation which does not affect the question of ungulate affinity either way. There are really several questions involved; shall we waive the structure of the terminal phalanges and call this genus an Ungulate? Shall we then direct our attention upon the teeth and carpals and tarsals and call it a Perissodactyl, or shall we follow Cope and remove it entirely to the Unguiculata? Let us sum up some of its leading characters:

CHARACTERS OF CHALICOTHERIUM.

Shared by Ungulates.	*Shared by Perissodactyla.*	*Not found in Perissodactyla.*
Radius transverse proximally, with two fossæ for humerus.	Tridactyl manus and pes.	Not mesaxonic.
Tibia with two fossæ, spine and crest.	Astragalus and all carpal and tarsal facets diplarthrous.	Main axis through fourth digit.
Calcaneum with broad sustentaculum.		Secondary unquiculate modifications of limbs and phalanges.
Diplarthry in carpus and tarsus.		Third trochanter absent.
Jaws with elevated condyle and broad angle.	Buno-selenodont molar type.	Large curved tympanic bullæ.
Molar teeth of sexitubercular origin.		Reduction of upper incisors.

This table shows that there are many characters, beside the form of the phalanges, which excludes this family from the Perissodactyla proper. The detailed comparisons of the skull which Depéret institutes with *Palæotherium* and *Palæosyops* relate to structures which are shared by all primitive Ungulates. The only structures in which there is apparently conclusive evidence of a remote relationship to this great division of the Ungulates is first in the teeth and second in the carpus and tarsus. It remains, therefore, to be seen whether these also are products of homoplasy or "parallel adaptation," or whether they really evince affinity.

Now let us turn to the broader question. Is *Chalicotherium* to be classed as an ungulate or as an unguiculate in the Linnæan sense? We should, of course, compare it first with the primitive ungulata which exhibit many unguiculate characters. We are again guided partly by the excellent figures and descriptions given by Depéret of *C. magnum* (race Rhodanicum). The skull resembles that of the Ungulata Condylarthra in many features. The occiput is very low and broad and widely overhangs the condyles. There is a well arched sagittal crest and a rather small cranium. The lower jaw has an elevated condyle and a deeply extended angle. The external auditory meatus is widely open below and there is a large mastoid process. The maxillary bones are high. All these characters are very similar to those in the skulls of the primitive Condylarthra, such as *Periptychus, Phenacodus* and *Meniscotherium.* We should also mention many cranial features which we believe belong to the category of secondary adaptive modifications; among such are the following: (1) the large curved cylindrical tympanic bullæ, (2) the feeble character of the nasals, premaxillaries and anterior portion of the mandibular rami. The latter modifications are associated with the reduction of the cutting teeth. Filhol has shown that the young individuals of Sansan have a full set of incisors, while in the adult the upper incisors are rudimentary or wanting.

There are other secondary features of note. The condylar facets are prolonged forward upon the basi-occipitals. The posterior face of the centrum of the axis is directed upward; this and the preceding features point to peculiar flexibility of the neck. The centrum of the axis is long and slender, the odontoid process is round, the spine is unusually long and high.

Looking again at the limbs we observe that the radius covers the entire front face of the ulna and presents two distinct fossæ for the condyles of the humerus. The tibia closely resembles that of some of the short-limbed ungulates in its cnemial crest and two fossæ for the femur, in its spine and distal grooves for the double trochlea of the astragalus which is like that in the short-footed *Aphelops.* This likeness to the ungulates, and especially to the perissodactyls, in the form of the upper foot bones and of their articulations with the metapodials is most striking. The calcaneum has a long tuber and very broad sustentaculum. The astragalus rests widely upon the cuboid, its tibial trochlea is very similar to that in the short-footed rhinoceroses. The cuboid, navicular and cuneiforms are, however, extremely flattened and specialized. The diplarthrous character of the carpus is precisely like that of Perissodactyla, the lunar rests upon the cuneiform and the scaphoid upon the magnum, while the metapodials abut laterally against the unciform and magnum.

Upon the whole we find that primitive and secondary ungulate characters decidedly predominate in the skull, teeth and skeleton. The secondary characters, especially in the ankle and wrist joints, are parallel with those in the perissodactyls, and are not mingled with unguiculate adaptations until we reach the phalanges.

Relation to the Unguiculata. Cope was the first to advocate the more radical view that this genus represents a distinct order. He wrote: "It has little relation to the family of Perissodactyla to which it has given the name (Palæosyops). Unlike the serial manus and pes of the edentata the carpus and tarsus are here diplarthrous in structure or displaced upon each other. While the Condylarthra are ungulate with an unguiculate carpus and tarsus, this order Ancylopoda presents the antithesis of including unguiculates with an ungulate carpus and tarsus." This antithesis he assigned as the main character of the new order.[2] He still considers the form of the terminal phalanges as of fundamental importance and believes (in a letter of May 14, 1892) that *Chalicotherium* must have been derived from some primitive unguiculate.

The ancestry of Chalicotherium. Without any knowledge of the ancestors of *Chalicotherium* we thus reach a dead lock. Shall the unguiculate structure of the phalanges outweigh the ungulate structures in other parts of the skeleton? Is it possible to derive such a skull and skeleton from any unguiculate or such terminal phalanges from any ungulate? In looking about for relatives of this genus we must now entirely discard the Palæosyops group, and hunt among the lowest Eocene types. The lowest Eocene unguiculates are wholly dissimilar. The only form at all similar is the genus Meniscotherium. Meniscotherium was a little plantigrade slightly larger than Hyrax, and of very similar proportions. It is found in the beds between the Wahsatch and Puerco and was even older than Coryphodon. The teeth are of the ungulate type known as

---

[2] Gill's term "Chalicotheroidea" was applied to these forms, considered as a super-family, equivalent to the Camelidæ, Giraffidæ, etc., and not as a suborder. Arr. Fam. of Mamm., 1872, p. 71–77.

"buno-selenodont." The feet are in the border region between the unguiculates and ungulates. This genus also occupies an isolated position; although placed by Cope in the family Meniscotheriidæ among the Condylarthra it is not even remotely related to any of the contemporary ungulates. Its molar evolution was precocious in both jaws, far more so than in Phenacodus. I was led to the idea that this might possibly be the long sought ancestor of Chalicotherium by the structure of the molar teeth. In 1886 Wortman regarded Meniscotherium as an ancestor of the Hyracoidea. Later Schlosser recognized the striking likeness of its molars to those of Chalicotherium, and considered it with Macrauchenia as a representative of Perissodactyla which had retained a primitive foot structure.

The comparison of the entire dentition of Meniscotherium and Chalicotherium led me in 1891 to the discovery of many very significant details of resemblance. In both, the anterior portion (or cutting teeth) of the dental series is reduced and the posterior or cheek teeth are enlarged. In both, the true molars have identically the same pattern in detail in both jaws, including the absence of the third lobe upon the last lower molar, which separates Meniscotherium from all early Condylarthra and Perissodactyla. I was especially struck also by the presence of a short posterior crest formed of the hypocone and hypoconule in the upper molars, and by the reduplication of the antero-internal tubercle (metaconid) in the lower molars. At the time only the upper tarsals of Meniscotherium were known; these possess the unguiculate characters which are exhibited in Phenacodus and all early ungulates but are distinguished by a *fibular facet* upon the calcaneum. It appeared to me altogether probable that the Wahsatch form was related to the ancestors of Chalicotherium, and that the question would be decided by the discovery of its feet. This discovery was reported sooner than was expected in Marsh's recent paper upon *M.* (Hyracops) *sociale* in which the fore and hind feet are fully figured.

The feet of Meniscotherium present only one feature which definitely points to those of Chalicotherium, namely, they are functionally tridactyl, the outer toes being much shorter than the three median toes. Marsh describes the terminal phalanges as *intermediate* between hoofs and claws, the extremities are thin, slightly expanded, and apparently covered by thin nails. In other respects the feet are very primitive and exhibit all the unguiculate features we now invariably expect to find among the primitive ungulates, namely, (1) the "centrale" and possibly (2) the "tibiale," (3) the fibular facet upon

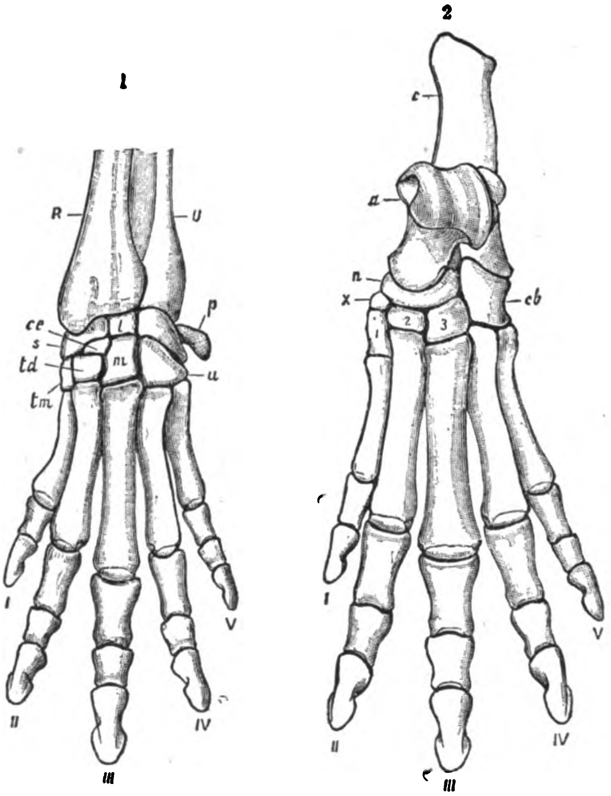


Fig 2. Fore and hind Feet of *Meniscotherium* (Hyracops) *sociale* after Marsh.

the calcaneum, (4) the "astragalar foramen," (5) the serial or undisplaced facets in both tarsus and carpus. As this was the parent ungulate type there is no insuperable difficulty in supposing that the ungulate carpus and tarsus of Chalicotherium were derived from those of Meniscotherium.

The terminal phalanges present a greater obstacle; is it possible that having progressed only so far toward hoofs as to be called "intermediate," they have subsequently retrogressed into curved claw-bearing ungues? I consider this possible but not in itself probable. We must not forget the manus of the subungulate Lemurs which bears three or four terminal nails and one large claw; or the phalanges of the unguiculate Mesonyx which are cleft, but also flattened and very ungulate in appearance. The line of division between claws, nails and incipient hoofs was not very sharply drawn. Another difficulty is seen in the fact that the median toe (III) of Meniscotherium is enlarged, it is mesaxonic; while the lateral toe (IV) of Chalicotherium is enlarged.

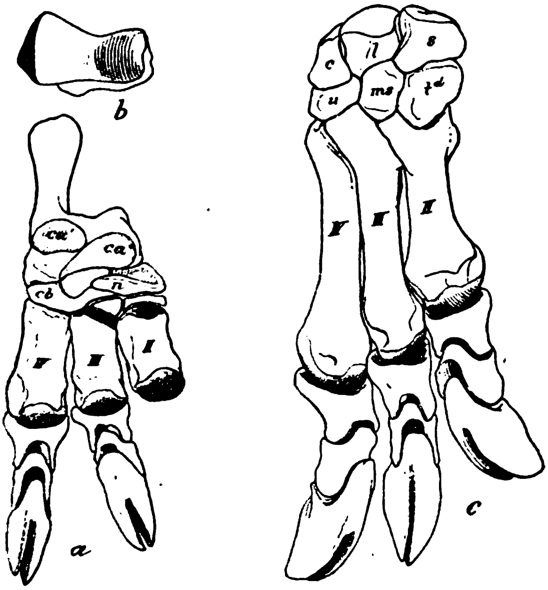


Fig 3. **Fore and hind Feet of *Chalicotherium* after Gervais, (from Sansan.).**

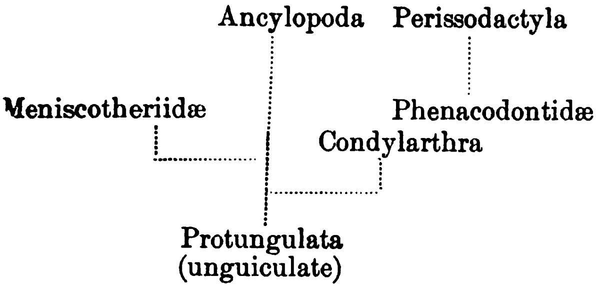
To offset these difficulties we find the striking similarities in the molar teeth already noted, and in the dental series as a whole. Meniscotherium is very exceptional in the absence of a third lobe to the last lower molar. The resemblance between the skulls of these two types is also very marked in the whole region behind the infra-orbital foramen. We see the same form of cranium, occiput, and auditory region.

I conclude, therefore, by giving a table of the resemblances and differences between the two types. Both are numerous. The question is, which are most fundamental?

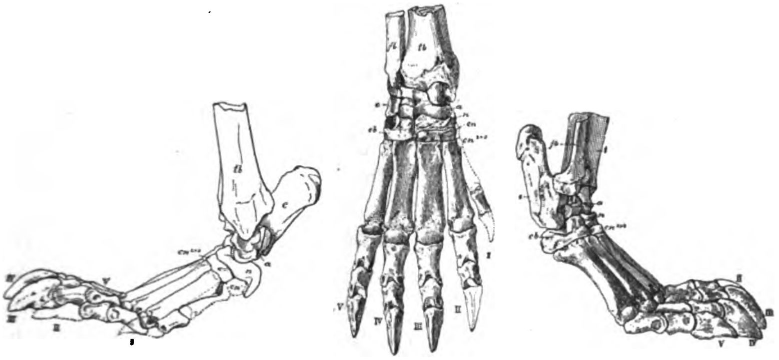
	MENISCOTHERIUM.	CHALICOTHERIUM.
1°	*Cutting teeth* somewhat reduced	Reduced or rudimentary.
	Upper molars, buno-selenodont	The same
	A short posterior crest. Protoconule large.	The same. Protoconule reduced.
	Lower molars lopho-selenodont	The same.
	Metaconulid reduplicate. No 3rd lobe on M^3.	The same.
2°	Five *digits.* Functionally tridactyl. Mesaxonic.	Three digits. Structurally tridactyl. Not mesaxonic.
	Carpus and tarsus, serial, (unguiculate type)	Displaced (ungulate type).
3°	Centrale, tibiale, 3rd trochanter, entepicondylar foramen, Fibulo-calcaneal facet	All wanting.
4°	Terminal phalanges sub-ungulate.	Unguiculate.
5°	Plantigrade.	Sub-digitigrade.

Many of these differences are such as separate higher from lower forms, especially those under 3° and 5°. We witness the loss of the primitive characters under 3° in many distinct phyla, also the modification of the characters under 2° and 5°.

I have now endeavored to clearly state the pros and cons of this question. The evidence for the original ungulate affinities of the Ancylopoda seems to me much stronger than that for its purely unguiculate origin. Supporting this view is the strong likeness of the skull and teeth of Chalicotherium to those of Meniscotherium, and finally the analogies which it presents to the perissodactyls in the modernization of the feet, wrist and ankle. My conception of its origin and zoological relations can be expressed in the following diagram.



The purpose of this paper is not, however, to express a final opinion but to suggest inquiry. While agreeing with Cope that the Ancylopoda represent a distinct division of the mammalia, we must admit that the broad zoological relations of this division are yet to be determined.



a. Internal. *b.* Anterior. *c.* External.

Fig. 4. Right hind foot of *Artionyx gaudryi.*

POSTSCRIPT.—THE DISCOVERY OF ARTIONYX.

The hind foot of *Artionyx gaudryi* was found last summer by the American Museum party, under Dr. Wortman, in the White River Miocene of South Dakota.

The discovery of this foot was one of those complete surprises which render palæontological research so fascinating. As indicated in the above article, we were daily expecting to find remains of Chalicotherium in the lower Miocene of America, but no one could have anticipated finding a type related, and yet so entirely different.

As Chalicotherium may be broadly termed an unguiculate perissodactyl, so Artionyx may be called an unguiculate artiodactyl. This, in fact, sums up the main difference between these types when we add that the terminal phalanges in the former are cleft, and in the latter are uncleft.

If this foot of *Artionyx* had the metatarsals cut off half way down, no one would hesitate to call it truly artiodactyl. The tibia, fibula, astragalus and calcaneum, the navicular with its posterior hook for the great-flexor tendon, the conjoined ecto- and mesocuneiforms, the nearly even pairs of toes on either side of the middle line—all these structures bear a marked artiodactyl stamp. The entocuneiform is missing, but there is no doubt that it supported a first digit; of which the proximal phalanx is fortunately preserved.

The distal ends of the metatarsals and the phalanges exhibit the same sudden transition to an unguiculate type which we observe in *Chalicotherium*, in fact they bear a very marked resemblance to the corresponding parts in the feet of the carnivora, until we come to the terminal phalanges, which are short, deep and laterally compressed, but not hooked or retractile. As observed above, they are not cleft.

The foot differs as widely from that of Chalicotherium as that of the pig does from that of the tapir. It is somewhat hazardous to make a deduction from the foot alone, but we have ventured to divide the Ancylopoda into two subdivisions.

ORDER.	SUB-ORDERS.
Ancylopoda. Ungulate, with unguiculate terminal phalanges.	A. *Perissonychia* (odd clawed), with perissodactyl tarsus and mesaxial reduction. Ungues cleft. B. *Artionychia* (even clawed), with artiodactyl tarsus and paraxial reduction. Ungues uncleft.

Subsequent discoveries may show that these are merely two families—the Chalicotheridæ and Artionychidæ. This discovery rather strengthens the idea of the relationship of Meniscotherium to the Ancylopoda—for we observe in Artionyx the fibulo-calcaneal facet of the older genus, also the depression upon the inner side of the astragalus.

RECENT BIBLIOGRAPHY.

1. Cope: "The Vertebrata of the Swift Current River, II." AMERICAN NATURALIST, March, 1889, p. 151 (species *C. bilobatum*, order Ancylopoda).
2. Depéret: "La Faune de Mammifères Miocènes de la Grive-St. Alban." Arch. Mus. d'Hist. Nat. d'Lyon, 1892.
3. Filhol: Assoc. Franç. Congrès Toulouse, 1888, p. 265.
   "Mammifères de Sansan." Ann. Sc. Gèol., 1891, pp. 294–300, Plates 43–46.
4. Gaudry: Journ. de Zool., 1875, Plate 18 (*Schizotherium priscum*).
   "Les Enchainments du Monde Animal." 1878, pp. 194–198.
   "Fauna Attica."
5. Osborn: "Chalicotherium and Macrotherium." AMERICAN NATURALIST, 1889, p. 729.
   "Meniscotheriidæ and Chalicotherioidea." AMERICAN NATURALIST, Oct., 1891, p. 911.
   "Is Meniscotherium a Member of the Chalicotherioidea." AMERICAN NATURALIST, June, 1892, p. 507.
   "Artionyx, a new member of the Ancylopoda." Bull. Am. Mus. Nat. Hist., February, 1893. (Osborn and Wortman.)

EDITORIALS.

EDITORS, E. D. COPE, AND J. S. KINGSLEY.

—BOTANISTS are waking up to the fact that they have too long neglected to conform to the law of priority in nomenclature. The return to older names of genera, species, etc., produces temporary inconvenience, but it is in the interest of stability, which is the fundamental condition of convenience in this matter. Persons who are accustomed to use certain names find it difficult to change them, and endeavor to make exceptions to the general rule, as some leading botanists are now proposing. But the sooner a clearing up of the whole matter is made the shorter will be the discomfort, for the law of priority is fundamental and must be supported under all circumstances that fall within the scope of nomenclature.

It is evident, however, that in cases which violate other laws of nomenclature, the law of priority has no application. Such are typographic and orthographic errors; also terms which cannot be given a Latin or Greek form. Such rules are the conditions of ordinary scholarship. There is another rule which belongs to scientific scholarship which has been hitherto respected, but which a small number of American zoologists are endeavoring to set aside. This is, that no name or term is available for scientific use which has not been accompanied by a definition prior to the publication of any other name for the same thing published with a description. So self-evident is the necessity of this rule that it has been adopted without exception by all scientific societies and committees in all countries which have proposed or revised laws of nomenclature. The primary element in all exact language is the definition of terms, and to omit this condition from scientific nomenclature is to abandon science and to go into literature, if mere word-making can be dignified by such a title. When we remember what a passion this word-making becomes in some persons, it is clear that science must have some protection from it. The only way that this protection may be had is to demand a *raison d'etre* for every name that is proposed. The student then knows with what he has to deal, and the proposer places himself on record in an available form. The abuses of the neglect of this rule are self-evident, since it lays the sciences open to charlatanism and to pretence of every description, and makes scientific literature of the catalogues of the showman and the salesman.

The only body which has encouraged this abuse is the American Ornithologists Union, which in its rules straddles the question. One result of this position is that members of that body are not a unit in their opinions on this point. A concrete case is the lists of names published a half century ago by Fitzinger. In his early days this naturalist made a creditable beginning of scientific work, but he soon lapsed into a cataloguer and list-publisher. He projected comprehensive systems which have little or no correspondence with nature, and filled them out with names without definitions, many of which are not applicable to anything which can be defined. So well known has this been in Europe that this work of his has been long since relegated to the waste heap, where it should by all means be permitted to remain. But the love of change has induced a few Americans at this late day to resuscitate this rubbish. No better motive can be ascribed for this resurrection, for it is not in accordance with existing rules; it is very inconvenient; and it opens the door to continued inconvenience of the same kind. It is a blow at scientific scholarship, and a distinct encouragement to dishonest work.

It is hardly likely that the botanists will split upon this rock.

—THE late meetings of the American Society of Naturalists and the allied societies of morphologists, anatomists and physiologists, held at Princeton, N. J., brought together a representative body of the most active workers in the natural sciences of the eastern part of the country. The west was ably represented by members from Cincinnati, Denison and Chicago Universities. These meetings add to the pleasures of the holidays, supplementing family reunions by professional reunions of men bound together by similarity of tastes and modes of thought. The advantages of these meetings are various, but one most obvious one is the stimulus to care and precision which results from free and friendly criticism. After living in an atmosphere of this kind, the mind more fully appreciates the contrast between the more or less careless, not to say disingenuous habits of thought that are so common, and the clear, rational, and truthful attitude of the mind which is so conspicuous in the workers in the fields of science. The welcome given by President Patton was as clear and honest as the minds of the men he faced, and it was a welcome to truth, let it come from what quarter it may.

The geologists were missed from an assembly which should include such a body of energetic workers as now constitute the Geological Society of America. In view of possible further segregation, a committee was appointed by the parent Society of Naturalists to suggest to the society some measures looking toward a combined organization, so that future cooperation might be assured. Such a combination would hold a winter meeting corresponding to the summer meeting of the American Association for the Advancement of Science, with the difference that it would consist of professional naturalists only.

—THE Smithsonian Institution has been requested by a petition signed by a large number of American naturalists and by a resolution of the American Society of Naturalists, to pay for the support of a table at the Naples Marine Biological laboratory to be occupied by American students. It would seem that such an appropriation of money is within the objects of the Institution as defined by the will of Smithson. As a school for original investigators, the Naples Laboratory has been, and doubtless will continue to be, of the greatest utility.

RECENT BOOKS AND PAMPHLETS.

Beal, W. J., and C. F. Wheeler.—Michigan Flora. From the States Agri. Coll. Mich.

Benedict, J. E.—Preliminary Descriptions of Thirty-seven New Species of Hermit Crabs of the Genus Eupagurus in the U. S. National Museum. Ext. Proceeds. U. S. Natl. Mus., Vol. xv, pp. 1–26. From the Smithsonian Institution.

Boettger, O.—Herpetologische Mitteilungen. Aus dem 29, 30, 31 und 32 Berichte des Oppenbacher Vereins für Naturkunde pag. 61, bis 164. From the author.

——Katalog der Batrachier-Sammlungen des Museum der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt am Main, 1892. From the author.

Bulletin No. 7, Iowa Agricultural Experiment Station, May, 1892.

Call, R. E.—The Tertiary Silicified Woods.——The Fishes of the Des Moines Basin.——On an Abnormal Hyoid Bone in the Human Subject.——Artesian Wells in Iowa. Exts. Proceeds. Iowa Acad. Science, Vol. i, Pt. 2, 1890–'91. From the author.

Cobb, N. A.—Arabian Nematodes. Ext. Vol. v, Proceeds. Linn. Soc. N. S. W. From the author.

Cope, E. D.—On Some New and Little Known Paleozoic Vertebrates. Reprint Am. Philos. Soc., May, 1892.

Darton, N. H.—Fossils in the Archæan Rocks of Central Piedmont Virginia. Am. Jour. Sci., July, 1892. From the author.

Day, D. T.—Mineral Resources of the United States, 1889, 1890. Seventh Report of the Series. From the Smithsonian Institution.

Derby, O. A.—Nepheline Rocks in Brazil. Ext. Quar. Jour. Geol. Soc., May, 1891. From the author.

DeVis, C. W.—Remarks on Post-Tertiary Phascolomyidæ.——In Confirmation of the Genus Owenia so-called.——The Incisors of Sceparnodon. Exts. Proceeds. Linn. Soc. N. S. W., 1891. From the author.

Donaldson, H. H.—The Extent of the Visual Cortex in Man as Deduced from the Study of Laura Bridgman's Head. Reprint Am. Jour. Psychol., Aug., 1892. From the author.

Etheridge, R.—On the Occurrence of the Genus Belonostomus in the Rolling Downs Formation (Cretaceous) of Central Queensland. Ext. Trans. Roy. Soc. Victoria, 1891. From the author.

Garman, S.—On Reptiles Collected by Dr. George Baur near Guyaquil, Ecuador. ——On Cophias and Bachia. Extr. Bull. Ess. Inst., 1892.——Dr. D. H. Storer's Work on the Fishes. Ext. Proceeds. Boston Soc. Nat. Hist., Dec., 1891. From the author.

Gaudry, A.—Excursion dans l'Amérique du Nord. Ext. Bull. Soc. Geol. de France, 3d série, t. xix, pp. 936–1024. From the author.

Gill, Th.—Note on the Genus Hiatula of Lacépède or Tautoga of Mitchell. Ext. Proceeds. U. S. Nat. Mus., Vol. xiv. From the author.

Hale, H.—Language as a Test of Mental Capacity, Being an Attempt to Demonstrate the True Basis of Anthropology. Ext. Trans. Roy. Soc. Can., Vol. ix, 1891. From the author.

HASSALL, A., AND C. W. STILES.—*Strongylus rubidus*, a New Species of Nematode Parasitic in Pigs. Reprint. Jour. Comp. Med. and Vetern. Arch., 1892. From the authors.

HITCHCOCK, R.—The Ainos of Yezo, Japan. Ext. Rep. Nat. Mus., 1890, pp. 429–502. From the Smithsonian Institution.

HOLLICK, A.—The Paleontology of the Cretaceous Formation on Staten Island. Ext. Trans. N. Y. Acad. Sci., Vol. xi, No. 5. From the author.

HOLM, TH.—Notes on the Flowers of *Anthoxanthum odoratum* L. Ext. Proceeds. U. S. Nat. Mus., Vol. xv, pp. 399–403. From the Smithsonian Institution.

HOUGH, W.—The Methods of Fire-Making. Ext. Rep. Nat. Mus., 1890, pp. 395–409. From the Smithsonian Institution.

HOWARD, L. O.—Insects of the Subfamily Encyrtinæ with Branched Antennæ. Ext. Proceeds. U. S. Nat. Mus., Vol. xv, pp. 361–369. From the Smithsonian Institution.

JAMES, J. F.—Of the Age of the Point Pleasant, Ohio, Beds.——On Problematic Organisms and the Preservation of Algæ as Fossils. From the author.

KOEHLER, S. R.—White-line Engraving in the Fifteenth and Sixteenth Centuries. Ext. Rep. Nat. Mus., 1890, pp. 385–394. From the Smithsonian Institution.

LEVERETT, F.—On the Significance of the White Clays of the Ohio Region. Ext. Am. Geol., Vol. x, 1892. From the author.

MATTHEWS, W.—The Catlin Collection of Indian Paintings. Ext. Rep. Nat. Mus., 1890, pp. 593–610. From the Smithsonian Institution.

POUCHET, G.—Contribution à l'histoire des Cyames. Ext. Jour. Anat. et Physiol. de l'Homme et des Animaux, 1892. From the author.

Report Regarding the Proposed Establishment of a National Aquarium in Sydney. 1892.

ROSE, C.—Ueber die v. Koch'sche Versteinerungsmethode. Aus Anat. Anz., 1892, Nos. 16 and 17. From the author.

SMITH, F.—The Gastrulation of *Aurelia flavidula* Per. and Les. Ext. Bull. Mus. Comp. Zool., Harvard Coll., Vol. xxii, No. 2. From the author.

STEINDACHNER, F.—Ueber neue und seltene Lacertiden aus den Herpetologischen Sammlungen des k. k. Naturhistorischen hofmuseums. Separat Abdruck aus Band vi, Heft. 3 und 4; Ann. des k. k. Naturhistorischen Hofmuseums. From the author.

STORER, H. R.—The Medals of Natural Scientists, Part 1. Ext. Proceeds. Newport Nat. Hist. Soc., 1888–1891.

Third Annual Report of the Geological Survey of Texas, 1891. From the Survey.

TOWNSEND, C. H. T.—A Remarkable New Hippoboscid from Mexico. Ext. Entomol. News, 1891, pp. 105–106. From the author.

UHLER, P. R.—Observations on Some Remarkable Heteroptera of North America. Ext. Maryland Acad. Sci., 1892, p. 179. From the author.

WADSWORTH, M. E.—The Doña Inez and the Llano del Inca Meteorites from Atacama, Chile, with Mineralogical Descriptions. Ext. Proceeds. Rochester Acad. Sci., Vol. 1. From the author.

WATKINS, J. E.—The Log of the Savannah. Ext. Rep. Nat. Mus. for 1890, pp. 611–639. From the Smithsonian Institution.

WEBER, M.—Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien. Zweiter Band. Erstes Heft. Leiden, 1891. From the author.

Williston, S. W.—Higher Professional Requirements. From the author.

Wilson, Th.—Anthropology at the Paris Exposition in 1889. Ext. Rep. Nat. Mus. for 1890. From the Museum.

Woodward, A. S.—On a Mammalian Tooth from the Wealden Formation of Hastings. Ext. Proceeds. London Zool. Soc., 1891.

——Supplementary Observations on Some Fossil Fishes of the English Lower Oolites. Reprint Proceeds. Geol. Asso., Vol. xii.

——On the Skeleton of a Chimeroid Fish (Ischyodus) from the Oxford Clay of Christian Malford, Wiltshire. Ext. Ann. Mag. Nat. Hist., July, 1892.

——*Pholidophorus germanicus*, an Addition to the Fish Fauna of the Upper Lias of Whitby. Ext. Geol. Mag., Dec., 1891.

——On the Lower Devonian Fish Fauna of Campbellton, N. B. Ibid., Jan., 1892.

——The Hybodont and Cestraciont Sharks of the Cretaceous Period. Ext. Proceeds. Yorkshire Geol. and Polytechnic Soc., 1891. From the author.

Woolman, L.—A Review of Artesian Horizons in Southern New Jersey. Ext. Ann. Rep. State Geol. New Jersey for 1891. From the author.

Ziegler, F.—Modelle zur Demonstration der Entwicklung der Zähne des Menschen. From the author.

RECENT LITERATURE.

Two Text-Books of Human Embryology.—Only a few years ago the physician who wished to know anything about the development of the human body found his whole supply of information in one or two chapters of his physiological text-book. In some respects the statements to be found there were reliable, but, at least in most American physiologies, they were strange misconceptions, as they could scarcely help being, for they were abstracts, at sixth or seventh hand of the wonderful researches of Bischoff, of Rathke and of von Baer, with never a bit of autoptic knowledge on the part of the compiler.

In the last two decades our knowledge of the embryology of man and of the other mammals has been greatly increased, so that the summary given by Balfour scarcely ten years ago is in many respects behind the times. So a new résumé in English is very acceptable. "It never rains but it pours." The same week brings to our table two works with essentially the same scope—that is the embryology of man and the mammals, with side lights on the lower vertebrates—but of greatly different treatment.

The first to be mentioned, Minot's Human Embryology,[1] is a large octavo volume, especially designed for the physician. That is, it seems admirably adapted to lead the medical student or practitioner into a clearer knowledge of the history of the human body, a knowledge of which the average physician has but the veriest smattering. Minot gives first an introduction in which he describes the uterus and outlines the stages of human development. Then the main portion of the book is divided into five parts. In the first we have an account of the history of the genital products and the theory of sex, together with a brief discussion of heredity. In Part Two the origin and meaning of the germ layers are discussed. This portion will prove more or less familiar to our readers, as several of its chapters have already been given in our pages. In the Third Part the chapters treat of the building up of the embryo, those of the Fourth of the fœtal appendages, while the Fifth Part takes up the fœtus. As an appendix given is an exceedingly condensed list of references to the authorities quoted in the text. Such a table of contents as that given above must fail to give an adequate idea of this book, and yet it is about as much of detail as our space will allow. In general we may say that the book pleases us; that while we find a few statements here and there which we might question, we feel deeply indebted to Prof. Minot not only for the compilation of such a valuable résumé of the work of other embryologists, but for the numbers of new contributions which we find in his pages. One feature which is of especial value, and which cannot but strike the reader, is the richness of citation of the works of other students. The illustrations also are good, and while most of them are process cuts, the majority have a freshness which is very pleasing.

---

[1] Human Embryology by Charles Sedgwick Minot. N. Y., William Wood & Co., 1892, pp. xxiii + 815.

The other work upon our list, Prof. Mark's Translation of Hertwig's Embryology,[2] does not need very extended mention, as the original has already been noticed in this journal. Its plan is greatly different from that of Minot in that after the introductory chapters of Part One the history of development is followed for the organs of the different germ-layers: Entoderm, mesoderm, ectoderm and mesenchym. The translation is done in a very satisfactory manner, and a careful reading of a considerable portion of the translation fails to reveal many of the "awkward renderings and German idioms" to which Dr. Mark refers in the preface. One feature of the translation deserves mention. For anlage the term fundament is used. Had this translation been introduced several years ago it might hope for general acceptation, but now that anlage is being bodily carried over into English (Minot, for instance, uses it throughout), we hardly think that the translation will prevail, especially in the face of the other and not obsolete meaning of the word. The printing of the text is good, but some of the cuts of the translation (clichès from the German cuts) are muddy and lack the clearness and delicacy of the German edition.

It would have been difficult to find two men better adapted for their respective tasks than these. For ten years Dr. Minot has been accumulating the materials for his portly volume, and he has had exceptional facilities in working over the preparations of some of the European masters. Dr. Mark, on the other hand, brings to the position of translator an accurate and detailed knowledge of the subject matter, and an almost extreme care that every word in his translation shall express, so far as the genius of our language permits, exactly the idea of his author. A comparison of the two works is difficult. For the student who has already a good foundation in the broader features of general embryology, possibly Mark's Hertwig will prove the more useful, for it gives more the broader features of ontogeny without paying great attention to minor and, for him, unimportant detail. Minot's work, on the other hand, from its method of treatment, may be better adapted for the *student* of medicine, for it takes up the subject more in accordance with the ideas which he receives from the rest of his special training, and in those points which may prove of value in questions of medical jurisprudence it gives a fulness of detail which is foreign to the purpose of the other work. Yet the average practitioner will probably have little to do with either volume. All that he cares to know concerning the questions discussed, would occupy very few pages, and the 670 pages of Mark's Hertwig, and the over 800 in Minot's volume, will, we fear, scare away the very men who most need the information they contain. Yet it is difficult to see how the matter could be much more condensed. The fault is not, in either case, with the author, but rather with the extent of our knowledge. This, however, will prove no drawback for the student of morphology, and, we doubt not, these will be two of the most consulted books in his library, for they are the two most important additions in our language to the literature of biology for the year 1892.

---

[2] Text Book of the Embryology of Man and Mammals, by Dr. Oscar Hertwig, translated from the third German edition by Edward L. Mark. London, Swan Sonnenschein; New York, Macmillan & Co. 1892, pp. xvi + 670.

To conclude, we would say that both books are valuable, and should be owned by all morphologists. Minot's volume is possibly the better adapted from its arrangement for the physician, and the greatest objection which we can see to its use by medical men is its size.

Geological Survey of Texas, 1891.[3]—This volume constitutes the Third Annual Report of the Geological Survey of Texas. It consists of the usual introductory statements of the State Geologist, E. T. Dumble, followed by the several reports of his assistants. The accompanying papers are reports on the geology and paleontology of important regions by specialists in those departments. Mr. Kennedy contributes the result of investigations which carried him across the post-cretaceous deposits, from Terrell, in Kaufman County, in a southeasterly direction to the mouth of the Sabine River. Mr. Cummins gives a detailed report on the geology of the Llaño Estacado. He traced the Carboniferous formation to its farthest outcrop in Central Texas, determined the northern extension of the Cretaceous along the eastern escarpment of the Staked Plains, and determined the extent of the Dockum and Blanco Canyon Beds and their relation to the underlying strata. The Stratigraphy of the Triassic formation in northwest Texas was assigned to N. F. Drake, who embodies his observations in a short paper of twenty-one pages. Mr. Steernwitz is still at work on the Trans-Pecos region. In his paper he states that rocks of Carboniferous age have been traced over a large area of this region, gives the age and relations of certain conglomerates, and the stratigraphic relationship between the schists and the red grit. Prof. E. D. Cope, who had in charge the fossil vertebrata, reports on collections from the Fayette formations, the Blanco Canyon bed, and the Triassic or Dockum beds. Dr. Sterki furnishes notes on shells found in a dry salt lake near Eddy, New Mexico.

---

[3] Third Annual Report of the Geological Survey of Texas, 1891. E. T. Dumble, State Geologist, Austin, 1892.

The illustrations are numerous and compare favorably with those of previous publications of the survey.

Mineral Resources of the United States, 1889 and 1890.[4]— This volume is the seventh of the series of Mineral Resources of the United States, and carries the statistical data to Dec. 31, 1890. An idea of the amount and value of the various useful mineral products is given in a brief summary which forms the opening chapter. The remaining 530 pages comprise carefully prepared statistical papers containing much valuable information.

According to the report the year 1890 was a period of unexampled activity in mining, particularly so in iron, silver, copper, coal and petroleum. The total value of the product is put at $656,604,698, an increase far beyond any previous year.

In addition to its individual index, this volume contains the general index to the entire series from 1882 to 1890 inclusive.

[4] Mineral Resources of the United States, 1889 and 1890. David T. Day, Chief of the Division of Mining Statistics and Technology, Washington, 1892.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Paleozoic Formations of Southern Minnesota.—A systematic account of the Paleozoic formations of southeastern Minnesota, by C. W. Hall and F. W. Sardeson, is given in the Bulletin of the Geological Society of America for 1892. The rocks described occupy an area some 13,200 square miles in extent. They stretch eastward from a straight line between Mankato and Hinckley to the State of Wisconsin, and from Chengwatona southward to Iowa. These periods of geologic time are represented by three formations: Upper Cambrian, Ordovician, and Devonian. These Paleozoic rocks are underlain by the Archean and Algonkian, and lie beneath patches of Cretaceous and a covering of quaternary débris save in the extreme southeastern corner included in Chamberlin's "driftless area."

The Upper Cambrian is represented in this region by the Potsdam sandstone and the Magnesian series; the Ordovician by the St. Peter, the Trenton, and the Cincinnati beds. The Devonian is present in so thin a layer in which so few fossils occur that it cannot be assigned to any division of that group, but is supposed to belong near the middle.

The writers give the following summary of thickness and leading lithological characters based chiefly upon their own measurements and determinations:

					FEET.
Devonian.	Not subdivided.		Limestone and shale		10–15
Ordovician	Cincinnati.	Wykoff.	Limestone	20	70
		Maquoketa.	Shale and limestone	20	
	Trenton	Galena.	Maclurea limestone	50	120
			Lingulasina limestone	20	
			Camarella shaly limestone	30	
			Orthisina calcareous shale	20	
		Trenton.	Zygospira shale	8	95
			Fucoid shale	20	
			Stictopora shale	30	
			Stictoporella limestone and shale	10	
			Blue limestone	12	
			Buff limestone	15	
	Saint Peter, not subdivided, sandstone				75–164
		Upper Shakopie dolomite			10–65
		Elevator B (Richmond) sandstone			20
Upper Cambrian.	Magnesian,	Lower Shakopie dolomite			75–175
		Jordan sandstone			75–200
		Saint Lawrence, dolomites and shales			30–218
	Potsdam, not subdivided, sandstones and shales				0–1,300
	Total thickness of Paleozoic strata in Minnesota.............				560–2,437

The Genus Hybodus.—According to Mr. A. S. Woodward, the genus Hybodus, which was determined solely from the evidence of the teeth and associated ribbed dorsal fin-spines, is now definitely determined by the other essential regions revealed by new specimens. The fossils in question comprise numerous skulls and two portions of the trunk of the typical *Hybodus basanus* from the Wealden of the Sussex coast.

The characters which afford information are (1) the presence of hooked cephalic spines, and (2) the occurrence of a vacant space between the neural and hæmal arches of the endoskeleton, which must have been occupied by a persistent notochord. Mr. Woodward is inclined to think that the presence or absence of cephalic spines will eventually prove to be a sexual character.—Proceeds. Yorkshire Geol. and Polytechnic Soc., Vol. xii, 1891.

On Some Dicynodont and Other Reptilian Remains from the Elgin Sandstone.—At the Aberdeen meeting of British Association in 1835, Dr. Traquair called attention to the skull of a *Dicynodont* which had been discovered in the Elgin sandstone of Cutlies Hillock (= New Spynie). Since that time several other specimens have been obtained from the same place, some of which are the property of the Elgin Museum, while others belong to the Geological Survey of the United Kingdom. These specimens are now being worked out by Mr. E. T. Newton, and the following is a preliminary note on the interesting results which have been obtained.

All the reptile remains obtained from Cutlies' Hillock are in the condition of hollow casts, the bones themselves having been dissolved away; this, it will be remembered, was the case with some of the examples of *Stagonolepis* from the Elgin sandstone, described by Prof. Huxley, and the method of taking casts from the hollow cavities which was adopted in that case, has been found of great advantage in the present instance. The blocks when brought from the quarry were more or less split open, exposing portions of the specimens. In some cases these cavities were traced out and developed with the chisel, while in others they were further split open, thus allowing casts to be taken. In many cases these casts had to be made in several parts and afterwards fitted together. The time and labor involved in this task have been repaid by the restoration of the skulls and parts of skeletons of several *Dicynodonts*, and one or two other equally remarkable forms of reptiles.

In most of these specimens, including that noticed by Dr. Traquair, the skulls are similar in form, although differing in minor details, and have a general resemblance to the South African *Dicynodon* and *Oudenodon*, some of them having small tusks in the maxillary bones. With most of these skulls parts of the skeleton have been found. Two or three show the position of the vertebral column and ribs, but up to the present no definite centra have been traced; besides this there is evidence of scapula, clavicle, humerus, radius, and ulna, the humerus having the characteristic anomodont expansion of the two extremities. In two specimens the ilia are preserved. These forms appear to be distinct from *Dicynodon*, and probably represent at least two or three species.

Another skull presents most of the characters of *Lystrosaurus*, but has a short muzzle and no teeth. The last, and by far the most remarkable skull of this series, is about six inches in length, and has the outer surface completely covered in by bony plates, the nostrils, eyes, and pineal fossa being the only apertures. The chief feature of this skull is the extreme development of horns upon the face and cheeks, there being about thirty of these formidable defences varying from about a fourth of an inch to nearly three inches in length, besides some smaller bones. The dentition is pleurodont, and resembles very closely that of the living Iguana; the palate is lacertilian, but with the pterygoids united in front of the pterygoid vacuity. This skull reminds one very strongly of the living *Moloch* and *Phrynosoma*, but it probably finds its nearest ally in the *Pareiasaurus* from the South African Karoo bed. The detailed description of these specimens is nearly completed and will, it is hoped, be shortly published.—Geol. Mag., Nov., 1892.

Cenozoic Insects.—In discussing the Rhynchophora of North America, Mr. S. H. Scudder refers to the variety and abundance of insect life during the early Cenozoic period as follows:

"In the earlier Tertiaries we not only possess in profusion representatives of every one of the orders of insects, but every dominating family type which exists to-day has been recognized in the rocks; even many of the families which have but a meager representation to-day have also been discovered, and though many extinct genera have been recognized, no higher groups, with a single exception or two, have been founded upon extinct forms. This is one of the most striking facts which confronts the student of fossil insects. It is the more striking from the delicacy, the tenuity, and miniatures of many of the forms which are here concerned; and the statement can be enforced by the further fact that the parasitic groups—those which are entomophagous—are represented, as well as many of those which in the present time show peculiar modes of life; thus we have representatives of such microscopic parasitic insects as Myrmar, strepsipterons have been discovered, the viviparity of the ancient Aphides has been shown probable, the special sexual forms of ants and white ants were as clearly marked as to-day, and the triungulin larva of Meloe has been found enclosed in amber, showing that the phenomenon of hypermetamorphism had already been developed.—Proceeds. Boston Soc. Nat. Hist., Jan., 1892.

Uplifts in the Sierras of California.—A paper of Mills in the Bull. G. S. A., Vol. 3, contains the following account of the orographic movements from which result northern half of the Sierra Nevada range.

Along the axes of the greatest uplifting of the present range a pre-Mesozoic range arose carrying up both crystalline and metamorphosed sedimentary rocks, which partially disappeared through erosion and subsidence; then a mesozoic range arose and its strata became uptilted, and it in turn was reduced by erosion and subsidence to very small proportions, and then in Tertiary and Quaternary time has arisen the present range, which is now undergoing its erosion."

A New Pliocene Ruminant.—The right mandible of a large animal found in the lowest Pliocene formation in the vicinity of Oran has been referred to the order of Artiodactyla by M. Pomel under the name *Libytherium maurusium.* In dimensions it rivals Helladotherium, with which it has some affinities, but from which it differs unmistakably. The fossil measures 30 centimetres from the posterior border of the last molar to the posterior part of symphysis.—Revue Scientifique, July, 1892.

A Remarkable Artiodactyle from the White River Epoch.—In a late number of the Bulletin of the American Museum of Natural History, Drs. Osborn and Wortman describe a species of Artiodactyle which differs much from any form previously known. A considerable part of the skeleton was obtained, together with crania of both male and female. The superior premolars (except the last) are simple, thus excluding the genus from the Boöidea, and the cuboid and navicular bones are distinct, a character which separates it from the Tragulidæ. The cervical vertebræ are undescribed, but the characters in general refer it to the Oreodontidæ rather than to any group of the camel series. The metapodial bones are distinct, and there are four in front and two posteriorly. Both sexes have a pair of low horn-cores or tuberosities on the parietal bones, but the male has other tuberosities and processes as follows: The superciliary borders are produced posteriorly into a prominent lobe, and a low tuberosity rises from the frontal at its anterior border, just in front of the orbit. Each maxillary develops an anteriorly projecting process above the last premolar tooth, and then rises into a huge elevated compressed plate with thickened apex at the side of the narrow nasal fissure. The latter opens far posteriorly, as the nasal bones are very short and wide. The molar teeth are Oreodontoid, and the superior canines are worn posteriorly, showing that there was a large inferior first premolar as in Oreodon. The canine has also the triangular section seen in that family. The inferior canine is recumbent, and resembles an incisor. No superior incisors.

The absence of superior incisors is a character which is uncommon in the Oreodontidæ, but is found in the genus Merycopater, and probably in Pithecistes. The discovery of a horned member of the group is interesting. The female of the species was first described by Marsh under the name of *Protoceras celer*. It is probable, however, that it is nearly allied to, if not actually pertaining to the genus Stibarus Cope, described in 1873. The latter was founded on a fragment of lower jaw with premolar teeth, a part which has not been found in the species described by Drs. Osborn and Wortman. The latter was found by Dr. Wortman in the upper White River beds; the *Stibarus obtusilobus* is a smaller species, and comes from the lower beds of the same series. I give figures of parts of the skeleton from clichés kindly furnished by Dr. Osborn (Plates I and II).—E. D. Cope.

The White Clays of the Ohio Region.—In southeastern Indiana and southwestern Ohio occur a series of clays overlying the glacial beds and differing from them in color and structure. There are similar clay deposits in southern Ohio outside the glacial boundary. Mr. Frank Leverett, in a paper published in the Amer. Geol., July, 1892, cites evidence to show that these deposits are synchronous, that they have a common origin, that that origin is independent of both ice-dams and organic agencies, but is best explained by a fluvio-lacustrine hypothesis. Furthermore, they furnish important evidence concerning the sequence of events in this region during the glacial period.

Geological News, General.—Mr. R. S. Tarr has published a paper in the Am. Geol., July, 1892, calling attention to the relation of secular decay of rocks to the formation of sediments. The essay is in the main a summary of the present knowledge of secular disintegration.——The rocks of the Guadalupe Mountains are referred by R. S. Tarr to the Upper Coal Measures instead of the Permian as determined by Shumard. Bull. No. 3, Geol. Surv. Texas.——A Geological and Agricultural Survey of the State of Louisiana has been undertaken in the interest of agriculture, the first publication of which has just been issued. It consists of a preliminary report on the northern part of the State, by Dr. Otto Lerch, covering the Topography, General Geology, Water Supply, Distribution of Soils and Useful Minerals.——M. Adolph Carnot states that the relative age of fossil bones can be ascertained by estimating the amount of fluoride of calcium entering into their percentage composition. His method was applied recently to determine whether a human tibia was contemporaneous with the bones of animals with which it was associated. The chemical analysis proved that the tibia contained only the same percentage of fluoride as a recent human bone, while the associated animal remains yielded seven to nine times as much fluoride as their recent analogues. Hence the tibia in question belongs to a later period than the other fossils with which it was found, a result in which M. Rivière acquiesces on other grounds.—Comptes-Rendus, Vol. cxv, pp. 337–339.

Archean.—Dr. Charles Barrois announces the discovery of Radiolaria in the Archean rocks of Brittany. The fossils occur in a fine siliceous matrix (phtanite) associated with fragments of graphite, in the neighborhood of Lamballe, Côtes-du-Nord. M. Cayeux, to whom the fossils were submitted, regards them as simple Radiolaria, of the family Monosphæridæ.—Natural Science, Oct., 1892.

Paleozoic.—According to Dr. Rüst, Radiolarian fossils are abundant in Paleozoic rocks, and nearly all of the Paleozoic Radiolaria can be referred to the genera recognized by Haeckel in the seas of to-day. —Palæontographica, Vol. xxxviii, pp. 107–200.

Three new species of fish—*Protodus jexii*, *Diplodus problematicus*, and *Acanthodes semistriatus*—have been added to the list of Lower Devonian Fish-fauna by Mr. A. S. Woodward. The fossils were collected by Mr. Jex at Campbellton, New Brunswick, and are now in the British Museum.—Geol. Mag., Jan., 1892.

Mr. J. C. White reports a small collection of fossil plants from the Wichita beds of Texas. They are essentially the same with the flora from southwestern Pennsylvania described by Prof. Fontaine. This makes an equivalency probable between the uppermost beds of the Carboniferous system in West Virginia, southwestern Pennsylvania and southern Ohio (the Dunkard Creek series), and those of the Wichita beds of Texas—Bull. Geol. Soc. Am., Vol. iii.

Mesozoic.—A Termite, discovered in the English Lias by Mr. Montagu Brown, exhibits even the patches of pigment on the wings. It is described by Dr. Henry Woodward in the May number of the Geol. Mag. under the name *Palæotermes ellisii.*——Mr. A. S. Woodward reports *Pholidophorus germanicus* from the Upper Lias of Whitby, Yorkshire. This Lepidosteoid fish was observed by Quensted in the Lias of Würtemburg and named in 1858.—Geol. Mag., Dec., 1891.——A mammalian tooth discovered by Mr. Charles Dawson has been given the provisional name *Plagiaulax dawsonii* by Mr. A. S. Woodward, who describes and figures it in the Proceeds. London Zool. Soc., Nov., 1891. This fossil is the first evidence of a European Cretaceous mammal.——A fine specimen of Belonostomus from the Rolling Downs formation (Cretaceous) of Central Queensland is described and figured by Mr. Etheridge in the Trans. Roy. Soc. Victoria, 1891, under the name *Belonostomus sweetii.* The specimen is supplemented by four other fragments so that all the more important features in the skeleton of the fish are made known.

Cenozoic.—A proof of the identity of the diatomaceous beds of New Jersey, Delaware and the outcrops on the western shore of Chesapeake Bay is afforded by the presence of a single specific form of diatom, Heliopelta, which occurs at the base only of this bed, and has not been found elsewhere in the world, either fossil or recent.—Ann. Rep. State Geol. New Jersey, 1891.——Mr. Harlé reports the finding of the right mandible of a monkey in a cave in the stone quarry of Montsaunés. The fossil in question is that of a Macaque and as it appears to Mr. Harlé to be a distinct species, he has given the name *Macacus tolosanus.*—Comptes-rendus, fev. 1892.——A list of Birds from the so-called Post-Pliocene drifts of Queensland, by Mr. De Vis, is an interesting contribution to avian literature. The list comprises twenty-eight species referred to twenty-four genera. The whole of the twenty-eight species and seven or perhaps eight of the genera are extinct. This change is very much the same as that observed in the case of the marsupials.—Proceeds Linn. Soc. N. S. W., Vol. vi.

ZOOLOGY.

The Cercaria Stage of Amphistomum.—Dr. Albert Lang has completed[1] the life-history of *Amphistomum subclavatum.* The adult lives in the frog, the young in the small *Planorbis contortus* of Germany. He finds that the young become encysted upon the skin of the frog, and as this is eaten at the time of molting the young obtain access to the alimentary canal in that way. Lang also describes some points in the anatomy of the Cercaria. Especially interesting is the description of the excretory apparatus which cannot well be reproduced without a figure.

Fecundation of the Eggs of Clinus argentatus.—M. Frederic Gintel gives the following account of the habits of a fish known as *Clinus argentatus* during the deposition of the eggs and their fecundation by the male:

"The extrusion of the eggs occupies about half an hour, and they are deposited among the branches of a clump of seaweed, after which the female goes away and the male comes in his turn to the algæ to fertilize the eggs, of which he then becomes the guardian until they are hatched, driving away all the males and females that come near to the nest. If the latter, however, are gravid, he invites them to lay their eggs near those which he is already guarding. M. Gintel has seen a male fecundate successively, and to care for seven separate depositions by as many different females, at intervals of several days. —Revue Scientifique, Août, 1892.

Preliminary Descriptions of New Fishes from the Northwest.—In the November number of THE NATURALIST we described a few of the new species collected in western Canada. We shall here describe in a brief way the remainder of the new species. Full descriptions as well as a general report on the collections and a comparison between the fish faunas of the Red River of the North, the Saskatchewan, the Missouri, the Columbia, and the Fraser River will appear later, the MS. of the entire report being ready for the press.

1. *Pantosteus columbianus* E. & E.

Three specimens, 92–100 mm. Boise River, Caldwell, Oregon.

Related to *P. generosus*, the eye larger, the caudal longer. Head

---

[1] Berichte Naturf. Gesell. Freiburg vi, 81, 1892.

4⅖–4⅗; D. II, 11½ or 12½; A I, 8½; scales, 16–19–80–100–15; eye, 1½–2 in. snout, 1⅕ to 1⅗ in interorbital, 3¾ to little more than 4 in head. All the fins pointed, the caudal lobes considerably longer than the head. Light brown, with indistinct clouds of darker.

2. *Notropis albeolus* E. & E.

One specimen 73 mm. long. Medicine Hat, Assiniboia.

Related to *N. maculatus* and *N. heterodon*. D. 9½; A. 8½; scales, 4–35–4; 15 scales before dorsal; teeth 4–4, 1, 2.

More slender than *heterolepis*; fins all small; origin of dorsal over ventral, equidistant from base of middle caudal rays and nares; scales closely imbricated, the exposed edges little higher than long. Lateral line decurved, the tubes developed on fewer than ten scales; ventral surface entirely white; a plumbeous lateral band overlaid with silvery; a dark vertebral line from occiput to caudal; sides with a few dark specks, dorsal surface more densely specked, the margins of the scales darker.

3. *Notropis heterolepis* E. & E.

One specimen 35 mm. long. Fort Quappelle.

Related to *N. heterodon* and *N. anogenus*. D. 9½; A. 9½; scales 5–35–4; 15 scales in front of the dorsal; teeth 4–4; dorsal inserted equidistant between base of upper caudal rays and anterior margin of eye, behind the last ray of the dorsal; scales loosely imbricated, almost imbedded in front of the dorsal; scales along the median line with a deep notch near the middle of the posterior margin; the line nearly straight; a few black specks along the base of the anal, a dark line from anal to caudal; a dark band from tip of snout along the sides to the caudal; a conspicuous black curved line at the base of each scale of the lateral line; all the scales above the lateral band dotted with black; a narrow vertebral line from occiput to dorsal, a broad dusky band on the back between the dorsal and caudal, between this and the lateral band a lighter band; scales of back with dark markings; series of minute black dots along each ray of the dorsal, anal and anterior portion of pectoral; dorsal and caudal quite dark.

4. *Notropis reticulatus* E. & E.

Twenty-four specimens from Fort Quappelle. Thirteen specimens, the largest 76 mm. from Brandon.

Related to *N. spectrunculus, fretensis, nitidus* and *topeka*. It approaches nearest to *N. fretensis* and *topeka*. From the former it differs chiefly in the larger scales in front of the dorsal and from the latter in the naked breast.

Head 4, depth 4–4½; D. 9½ or 10½ (I or II, 8½); A. 9½ (II, 7½); scales 4 or 5–34–3 or 4; scales in front of dorsal, 12 or 14; teeth 4–4, hooked, with evident grinding surface; head pointed, broad above, and slightly convex; snout decurved, pointed, the lower jaw included; mouth oblique, the premaxillary on a level with the lower margin of the pupil or somewhat lower; maxillary reaching front of orbit; eye large, considerably longer than snout, 3 in head, greater than interorbital; origin of dorsal over ventrals, equidistant from tip of snout and base of upper caudal rays; longest ray scarcely extending beyond tip of last when depressed; anal low, the longest ray not extending beyond tip of last when fin is depressed, equal to snout and eye; ventrals reaching vent, slightly longer than the highest anal ray; pectorals little longer than head, less opercle; scales closely imbricated, the exposed edges considerably deeper than long in the largest specimens; lateral line decurved, complete; breast naked.

Dark streak from anal to caudal, lower parts otherwise plain; a dark vertebral line, a plumbeous band along the side: a faint spot at the base of the caudal about as large as the pupil; a series of spots along each side of the lateral line; upper parts of sides and the back profusely spotted, the edges of the scales are black, giving the whole part a reticulated appearance. The specimens from Quappelle are darker than those from Brandon.

5. *Notropis scopiferus* E. & E.

Many specimens from Winnipeg, Brandon, Fort Quappelle, Medicine Hat.

This species is evidently closely related to *N. luciodus*, from which it differs in having a conspicuous jet black spot about as large as the pupil at the base of the caudal fin.

Head 4–4½; depth 4½; D. 9½; A. 10½ (II, 8½); scales 6-36 to 42-4; 14–18 scales in front of the dorsal; teeth 2, 4–4, 2 grinding surface very narrow, on two teeth only; head heavy, compressed, flat above; snout blunt, much decurved; mouth small, little oblique; maxillary extending to eye; eye, 3 in head, little less than interorbital; lateral line complete, evenly and gently decurved to above origin of anal; a conspicuous black spot at the base of the middle caudal rays; a silvery lateral band, its dorsal margin distinct, color otherwise variable.

6. *Agosia fulcata* E. & E.

Many specimens. Boise River, Caldwell, Idaho.

Scales larger and fins much longer than in *A. nubila*.

Head 3¾; depth 4½–5¼; D. 11½; A. 9½; scales 53–60, about ten above the lateral line; dorsal usually inserted directly over the origin of the ventrals, the fin large, its anterior rays prolonged; origin of dorsal equidistant from base of middle caudal rays and nares; caudal deeply forked, the lobes acute, 3⅗ to 3⅘ in the length; anal rays 4⅛–4¾ in the length; ventrals always more posterior in position than in *nubila*, their tips extending to or past middle of base of anal; pectorals not reaching ventrals.

A dark band forward from eye; dark lateral band scarcely evident; silvery below; sides and back with numerous irregular, well-defined dark blotches; anal and sometimes ventrals with a dusky spot near base in front; dorsal and caudal faintly mottled; crimson spots on mandible, axil of ventrals and along base of anal.

7. *Agosia shuswap* E. & E.

Four specimens. Shuswap Lake, near mouth of Eagle River.

These specimens differ from *A. falcata* in a few characters; intergradations may be found, but none exist in our specimens.

Dorsal equidistant from base of middle caudal rays and posterior half of eye, inserted directly over origin of ventrals; lateral band well marked, otherwise as in *A. falcata.*

C. H. and R. S. Eigenmann.

The Larynx of Batrachia.—Dr. H. H. Wilder states[2] that Amphibia typically possess two pairs of laryngeal cartilages, an anterior pair of arytenoids, while the posterior, containing tracheal rings as well as the future cricoids, are best called tracheal elements. In Proteus and Necturus but one pair is present, while in many Anura the tracheal elements fuse in the median line, forming a sort of cricoid. Wilder suggests, arguing from position, innervation, and musculature, that the arytenoids are the fifth branchial arches and are further homologous with the so-called inferior pharyngeal bones of Teleosts. The tracheal elements, on the other hand, are new formations.

The Kidney of Amphiuma.—Dr. H. H. Field has studied the kidney anlage in young Amphiuma and finds[3] that here as in the Caecilians as described by Semon, there is a true metamerism. In his material (which has already served for other studies published in these pages[4]) the kidney reached back to the cloacal region, and it was possible to follow the different stages of formation of the canals. In the caudal region in the middle of each somite there was a wide, sharply

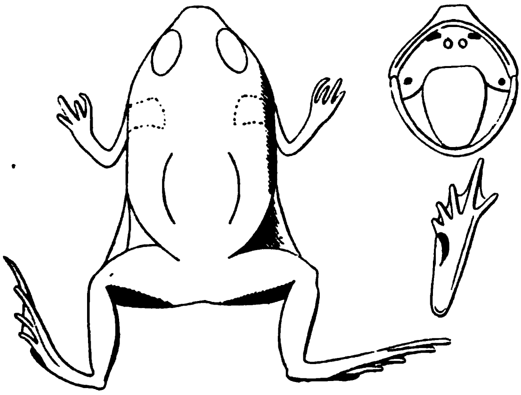
[2] Anat. Anzeiger, vii, 570, 1892.

[3] Verh. Deutschen Zool. Gesellschaft, 1892, p. 113.

[4] Hay, Am. Nat.. xxii, p. 315, 1888; Kingsley l. c. xxvi, p. 671, 1892.

bent tube which communicated on the one hand by a nephrostome with the body cavity, and on the other empties into the segmental duct. Immediately above the nephrostome was the malpighian body. Going forward the looping of the duct becomes more extensive, and extends from wall to wall of the somite, but no anastomoses occur and the nephrostome is always in the middle of the somite. The ontogeny of this organ will doubtless prove of extreme interest, and this point goes to support Cope's thesis of the relationships of Amphiuma to the Gymnophiona.

On a New Spade-Foot from Texas.—*Spea laticeps* sp. nov. —Frontoparietal bones without fontanelle, smooth. Form of head and body short and wide. Width of head at tympana entering length of head and body two and one-quarter times. Front wide and perfectly flat, its width entering the length of the tibia two and one-quarter times, and considerably exceeding the width of an eyelid. Muzzle projecting little beyond lip; nostrils nearly terminal; canthus rostralis not marked; tympanum concealed; vomerine fascicles small, posterior to a line connecting the choanæ. The latter exceed in diameter the well-developed ostia pharyngea of the eustachian tubes.



Spea laticeps Cope, nat. size.

The heel of the extended hind leg reaches the position of the tympanum. Its digits are half-webbed, three and one-half phalanges of the fourth digit remaining free. On closing the fingers the second a little exceeds the third in length, and the third exceeds the fifth. The integument of the superior and lateral surfaces extends to or beyond the middle of the femur. It is obscurely tubercular, and the inferior surfaces are smooth. There are no distinct glandular aggregations of crypts. The length of the head and body is 38.5 mm.; length of head (axial), including tympanic region, 14.5 mm.; width of interorbital space, 6 mm.; of head at tympana, 18 mm.; length of fore leg from axilla, 19 mm.; length of hind leg from urostyle, 41 mm.; length of tibia, 12.5 mm.; of foot, 20 mm.

Color of superior surfaces brown, varied with large obscure spots of dark brown.

There are no pale longitudinal stripes, but the borders of the sacral region are pale and contract posteriorly, enclosing a narrow dark band above the urostyle. This pale outline is bordered externally by brown, and from this dark spots or bands extend transversely. There is a dark spot on the canthus rostralis; one on each side of the end of the muzzle, one below the eye, and one posterior to the eye. Gular region light yellow, rest of lower surface dirty white. Sheaths of hallux black bordered.

The single specimen of this species before me is smaller than the average *S. hammondii* proper, and is equal to the larger individuals of the *S. h. bombifrons.* Its color and the position of its vomerine teeth are more like those of the *Scaphiopus couchii,* but the proportions and the perfectly smooth cranial bones with free integument, distinguish it readily.

This interesting species approximates more closely the genus Scaphiopus than the known species of Spea. It was found by Mr. Wm. L. Black, of Prof. W. F. Cummins' party of the geological survey of Texas, on the journey between Seymour, in northwest Texas south of the Red River, and Austin. Mr. Black obtained on the same expedition three species of Bufo, viz., *B. compactilis, B. debilis* and *B. punctatus.* The range of the last named is thus much extended eastward. A specimen of the snake *Tropidoclonium lineatum* was also obtained, which extends its range much westward, Dallas having been the previous limit in this direction.—E. D. Cope.

The Pedal Skeleton of the Dorking Fowl.—Mr. G. B. Howes has been studying the pedal skeleton of two Dorking chicks, reaching conclusions somewhat different from those of Mr. Cowper, who has recently published studies of the adult structure. As a result of his anatomical researches Mr. Howes advances the theory that the two innermost digits of the Dorking fowl's pes are the product of the cleavage of the hallux, and adduces the recent discovery by Kükenthal of an undoubted occasional splitting of the Cetacean pollex as a support of this argument. Mr. Howes states also that the types of the hexadactyle limb met with in the Amniota, as well as the pentadactyle pes of the Dorking fowl, is a monstrous formation, and that arguments deduced from their study in support of hexa- and heptadactyle limbs are premature. The author calls attention to the fact that inasmuch as no observed amphibian either living or extinct is known to have borne more than two phalanges upon its second digit, neither the sauropsidian nor the mammalian types can be derived from that of the Amphibia except by a process of intercalation such as there is no evidence to support. As involving the Mammalia, the force of the argument against a belief in the amphibian origin of the class it is second only to that of the discovery of the mammalian condition of the limbs in the Theromorous Reptiles.—Jour. Anat. and Phys., Vol. xxvi.

EMBRYOLOGY.[1]

Experimental Embryology.—Under this title may be included two most interesting recent contributions to our knowledge of the significance of the cleavage phenomena in animal eggs. Both deal with the cleavage phenomena of eggs influenced by experimental interference; the one in the case of a Vertebrate, the other in an Echinoderm.

Prof. E. B. Wilson,[2] of Columbia College, finds that the cleavage cells of an Amphioxus egg when shaken apart are yet capable of developing into gastrulas or even into complete larvæ of perfectly normal structure. Yet the *size* of the gastrulæ or larvæ is determined by the size of the cleaving cell; thus if one of the first two cells is taken the resulting gastrula is half the normal size, if one of the first four is taken, the gastrula is one-fourth the normal bulk. Gastrulas of one-eighth the normal size occurred but were not products of isolated cells in the eight-cell stage; in fact, the experiments go to show that one of these first eight cells is incapable of forming a gastrula. There is thus an early limit set upon the potentialities of the cleavage cells. This, moreover, seems to be a qualitative and not a quantitative limit. The homogeneous, undifferentiated character of the cells is lost at the eight-celled stage.

When the cells are incompletely separated, double, triple, and even quadruple embryos are formed.

Comparing the development of the isolated cells of Amphioxus with what is known of similar phenomena in other Vertebrates as known from the work of Roux upon the frog, or with the facts established for Echinoderms by Dreisch and others, we find an important and fundamental difference in the time at which individuation and symmetry become apparent. While in the Echinoderm the partial development proceeds at first as if all the cells were present, and only later what may, improperly, be called a process of *regeneration*, forms that which was lacking to the completion of a normal symmetrical embryo, in Amphioxus, as the author shows by diagrams giving more accurate observations than had hitherto been made upon the exact mode of cleaving,—"the isolated blastomere develops as a unit, not as a half-unit; and the cells to which it gives rise cannot be individually identified with those of a normal embryo-half. The development is transformed from the beginning."

---

[1] This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2] On Multiple and Partial Development in Amphioxus. Anat. Anz., 1892, Nos. 23–24.

The second paper, by Hans Dreisch, of Zürich,[3] contains many important facts not presented in the preliminary article noticed in the December NATURALIST.

When the eggs of certain sea-urchins are exposed to high temperatures an acceleration in the rapidity of cleavage processes is not the only result—but at a temperature of 31° C. certain marked changes both in the size and position of cells, the entire absence of micromeres and other such fundamental effects are produced. Nevertheless eggs that cleave in these abnormal ways may develop into perfectly normal larval forms, plutei. Long continued exposure to such temperatures acts like the mechanical force applied in shaking eggs in a test-tube and results in the separation of cleaving eggs into two, rarely more than two portions, each of which may then develop by itself. As some of these portions form normal larvæ, high temperature may be one of the factors concerned in the formation of multiple embryos.

Returning to the cleavage of cells separated by shaking echinoderm eggs, a series of figures are given to illustrate the fact that the isolated cells continue to cleave, for a time, as if still in combination with their fellow cells. Thus three cells taken from a four-celled stage do not at once fill up the gap left by the removal of the fourth and this fourth cell divides by itself just as it would have done if remaining in contact with the three others. It is only at a later stage that the products of isolated cells arrange themselves so as to form a complete, symmetrical individual.

A portion of the paper is taken up with certain abnormal methods of cleavage, beginning with the simultaneous formation of four instead of two cells, at the first cleavage. In these cases the cleavage continues to be *double*, a sixteen-cell stage having two sets of each eight cells comparable to the entire eight-cell stage of a normal egg. No larvæ could be reared from such eggs, yet special interest attaches to them upon the assumption that they owe their dual nature to a double fertilization. The only evidence that these eggs were fertilized by two sperms is the assumption by Fol and others that double fertilization causes the formation of four in place of the normal two first cleavage cells.

A most important addition to the methods of experimentation has resulted in unexpected results. It consists in subjecting echinoderm

[3] Entwicklungsmechanische Studien. Zeit. f. Wiss. Zool., 55, 1892.

eggs to mechanical pressure by the very simple expedient of allowing a cover-glass to rest upon them with more or less force as controlled by a hair inserted under the glass.

Eggs flattened out to several times their original diameter do not lose their power to develop, even when the egg membrane is ruptured. If the eggs are fertilized and undergo cleavage under pressure the resulting cells are not arranged in the form of a sphere but form a flat disk. This arrangement of the cells results from the arrangement of the nuclear spindles. While in a normal egg the spindles of the first four cells would stand vertically, as it were, and produce a new set of cells by a horizontal cleavage, under pressure the spindles are found all lying at right angles to the compressing force; that is, parallel to the cover glass or horizontally, and hence give rise to cells all lying in one plane. When the pressure is removed the cells remain at first in a flat disk, though each cell becomes rounded. Subsequent divisions of these cells give rise to a spherical mass capable of forming a complete normal embryo.

With the aid of figures the author makes it clear that in such cases material which would normally have taken part in the formation of only one pole or side of the embryo must now contribute to opposite poles or sides. In the sea-urchin there is thus no early specialization or differentiation of the material found in the cleavage cells; the mixing up of the blastomeres would not prevent the formation of a complete normal animal: the author concludes they could be mixed in all possible ways without destroying the normal symmetry of the adult.

In the philosophical discussion that takes up the final portion of the paper, the author considers the methods of morphological research and upholds the experimental method, which tends to promise the reduction of Biology to a scientific basis sooner than the descriptive, historical or mechanical lines of inquiry possibly can.

Studies in Insect Embryology.—Dr. H. Henking[4] having previously published extensive researches upon the formation, maturation and union of the sexual cells in *Pieris brassica* and *Pyrrhocoris apterus* concludes this comparative study with additional facts upon the eggs of the latter insect as well as those of *Agelastica alni, Donacia lampyris, Tenebrio, Lasius, Rhodites, Bombyx, Musca,* and other representatives of nearly all the chief groups of insects and then summarizes the whole with the aid of most interesting comparisons and suggestions.

---

[4] Zeit. f. Wiss. Zool., 54, 1892; 51, 1891; 49, 1890.

Along with the observation of normal processes, attempts were also made in some cases to influence these processes by increasing or diminishing the atmospheric pressure, by placing the egg in horizontal and vertical positions, by surrounding them with CO_2 and with O; but the results are not definite enough to afford more than suggestions for future work.

Regarding the maturation of the egg the author holds views that depend upon the interpretation of peculiar appearances seen in insect eggs, where, as is well-known, the technique is a most difficult factor.

The first polar body receives one-half of the chromosomes, one-half the normal number of the ordinary cell, and also the first *thelyid.* This *thelyid* or "acromatic polar body," is a rather vague mass of acromatic substance including the connecting filaments and adjacent substances between the two separating sets of chromosomes.

The second polar body receives the same number of chromosomes as the first, these being formed by a division of each, so that a half of each remains to form the egg nucleus; in some cases there is a second *thelyid,* but this remains inside the ovum.

The two polar bodies may separate completely from the egg, but more often they remain either in protoplasmic processes of its surface or entirely beneath its surface; the first polar body may divide into two.

Even when the polar bodies are extruded they may be later taken into the egg again. Their nuclei may undergo changes similar to that of the egg nucleus, either retaining the separate chromosomes or forming a chromatic network. The first and second or the product of the division of the first and second may fuse with one another inside the egg, much as the sexual pronuclei do.

Meanwhile numerous sperms may enter an egg; polyspermy in insects has no apparent injurious results. The sperm passes into the yolk in a bent attitude, with the union of head and tail preceding. A clear area about the sperm, the *arrhenoid,* seems to give rise to radiating striæ in the protoplasm. This peculiar body is regarded as formed from the acromatic connecting filaments given to the sperm at the second division of its mother cell; is thus comparable, in a way, to the *thelyid.* Increase in size and change in the sperms take place simultaneously in all that penetrate the yolk; only one meets and unites with the female pronucleus.

The number of chromosomes in the nuclei of ordinary somatic cells and in the cleaving egg is 28, 24, 20, 18–20, 24–30, in five different insects studied; the number in the first and also in second polar bodies in these same species, 14, 12, 10, 9, about 12. As far as studied the spermatocytes have also this same half-number after their first and second divisions; with some interesting exceptions the sperm and the polar body and the female pronucleus have the same number, in any species, and this is half the number of other cells of that species.

With the aid of a diagram the author emphasizes the close parallel between the formation of sperms and polar bodies. Starting from a mother cell with, say 24 chromosomes, a *reducing* division forms two sperm mother cells, or in the female an egg and a polar body, in each of which are only 12 chromosomes, and these are half of the original 24, unchanged or undivided individually. A second division of each cell results in the formation of four sperm mother cells or in the female of three polar bodies, and the remaining egg, in each of which are 12 chromosomes. These, however, are formed by an *equal* division, that is, from the previous 12, 24 arise by a division of each—not by the separation of the whole set into two sets as in division with *reduction.* Later the 12 chromosomes of a sperm may be added to the 12 of the egg nucleus to make the normal 24 of the cleavage nucleus, whence, by equal division, all subsequent cells have 24 also. Likewise, in the insects, one polar body may unite its 12 with the 12 of another polar body.

Utilizing the recent researches of Guignard,[5] the author draws a most interesting comparison between the processes taking place in insects and in plants. Without the aid of diagrams this can scarcely be rendered intelligible; the most novel part, however, is an attempt to explain the polar bodies of animal eggs as, in a sense, "larval organs," somewhat comparable to rudimentary structures within the embryo sac of a flowering plant.

The fact that in insects the polar bodies may remain within the egg and that they, or their descendants, may unite with one another, seems to form a parallel to what takes place in the flowering plant. As is well-known, the embryo-sac cell forms two sets of each 4 nuclei within its substance, 4 lower antipodal cells and 4 upper cells, of which one is the ovum.

The formation of these is directly comparable to the formation of polar bodies in the animal—supposing a second series of divisions to supervene and convert the 4, ovum and three polar bodies, into eight. In the embryo-sac a remarkable fusion takes place between one of the antipodal nuclei and the sister cell of the ovum; this union forms the endosperm. Compared with the insect, this union is like the fusion of polar bodies, only in a later generation. In the insect nothing appar-

[5] See this Journal, May, 1892.

ently results from the fusion of polar bodies; they are rudimentary larval organs.

The fact that we here compare union of later generations in the plant with that of earlier ones in the insect or animal is perhaps made less objectionable by considering the state of things in the infusoria, where, as Maupas has shown, the final fusion takes place between nuclei resulting from more numerous divisions than are employed in the formation of sperm and female pronucleus.

The observations of Henking upon the number and division of the chromosomes in insects conflict in an important particular with the facts necessary to support Weismann's theoretical explanation of the use of polar bodies. In his "Amphimixis" Weismann holds that *reduction* takes place in the formation of both polar bodies, and that there was previously a doubling in the number of chromosomes or *idanten* to allow of greater complexity of combination of the *iden* or hypothetical hereditary units found in the chromosomes. Hinking denies that the second polar body is formed by *reduction;* it is formed by an *equal* division. Moreover, there is no previous doubling of chromosomes; the apparent doubling is only a more or less pronounced division into parts still remaining subservient to the whole, not acquiring individuality.

Weismann's views are moreover limited in that they depend upon the occurrence of two polar bodies, two divisions in the formation of sexual cells; whereas in plants and in infusoria, nuclei that need to copulate result from more numerous divisions.

Parthenogenesis again, as seen in hymenoptera and lepidoptera, may occur where two polar bodies with a smaller number of chromosomes are present.

Though recognizing the strength of the evidence that heredity is closely associated with the chromosomes, the author thinks they are not unchangeable, and that at times they may be more intimately combined with the other parts of the nucleus. If the centrosomes are to be regarded in heredity as of like value with the chromosomes then we must seek in them a process of reduction before copulation.

All present theories of fertilization and of inheritance have only a provisional character.

ENTOMOLOGY.[1]

On a Small Collection of Coleoptera from the High Mountains of British Columbia.—A small series of Coleoptera furnished the writer by Messrs A. G. Smith and F. Russell is of interest sufficient to deserve notice; the collection was made near Donald, B. C., on the top of the first range of mountains to the northeast and above the base of the snow line. Some of the beetles are circumpolar species, others are melanistic forms of those found in more favored situations. A list of them with remarks is appended:

Carabus oregonensis Lec.

One specimen of the insect was taken; it is darker than those found on the coast and somewhat smaller.

Nebria sahlbergii Fisch.

Numerous specimens of small size and with rather dark legs. This seems to have been the most common beetle on the mountain, and is characteristic of boreal or mountainous districts; it extends from the White Mountains of New Hampshire to Alaska, and Dr. Hamilton writes that he has it from the Coast Range of the south of California.

Bembidium incertum Mots.

One specimen; this is reported from Sitka, Alaska.

Pterostichus riparius Dej.

Four specimens; these are a little smaller than those from the coast of Southern Alaska, but about the same as a number from the Stikine River of British Columbia. It has been reported from Gray's Peak, Colo., at an elevation of 12,000 feet. Dejean described it from our northwest coast in 1828 (Species General des Coleopteres, iii, 333).

Amara remotestriata Dej.

Three specimens were brought from the mountain top. It occurs in mountainous and northern regions of our continent.

Harpalus innocuus Lec.

Two specimens of this species are very black, but present no other difference.

Hippodamia 5-signata Kirby.

A series of five specimens show great variation in size and color the smallest one being also the darkest. One of them is remarkable in that the thorax has a large, perfectly regular fovea on each side near the middle.

---

[1] This department is edited by Clarence M. Weed, Hanover, N. H.

Hippodamia convergens Guer.

One specimen showing nothing of interest.

Coccinella transversoguttata Fabr.

One specimen of an ordinary type. Widely distributed in North America, and occurs also in Northern Europe and Asia.

Psyllobora 20-*maculuta* Say.

A specimen of this species is the most thoroughly melanized of any seen. All of the elytral spots, excepting the sub-apical, are more or less confluent, forming two irregular vittæ—one near the suture, the other discal. This would go under the variety *tædata* Lec., but is larger than typical 20-*maculata* instead of being smaller, as is usual with that variety.

Byrrhus kirbyi Lec.

One specimen.

Byrrhus cyclophorus Kirby.

Two specimens. This and the preceding species are northern or montane in habit.

Buprestis lanta Lec.

One specimen.

Podabrus xanthoderus Lec.

Four specimens of a *Podabrus* which agree with Dr. Leconte's short description of his variety *a* (Trans. Amer. Ento. Soc., ix, p. 48), are referred here. The mandibles and sides of the head are yellow, as are also the antennal tubercles and the first two joints of the antennæ. One specimen (possibly a distinct species) has the thorax entirely black, except a very narrow margin on the sides in front of the middle; it is also a little less in size, but seems to agree in other characters.

Aphodius ursinus Mots.

Two specimens of this fine insect are in the lot. It is a black variety of *aleutus*, according to the latest researches and is known from Colorado (Dr. Horn, Trans. Amer. Ento. Soc., xiv, p. 13) and from Kamtschatka. Compared with examples of *aleutus* from Southern Alaska these latter are only about half as large.

Aphodius granarius Linn.

Four rather large specimens. This species is found over nearly all of North America and the rest of the civilized world.

Aphodius congregatus Mann.

One specimen of the variety with testaceous elytra.

Acmæops proteus Kirby.

A specimen of this variable species is almost exactly like one from Ottawa, Canada.

Syneta albida Lec.

One specimen. The suture is narrowly dark, the thorax and head also quite dark. The species of *Syneta* vary in color and it is quite unnecessary to erect new species on such characters until the extent of this variation is more definitely known.

Goniodena arctica Mann.

Four specimens of this interesting species were taken, two of them nearly typical, differing from Mannerheim's description (Bulletin de la Societe Imp. des Naturalistes des Moscow, 1853, p. 166) only in the absence of the pale thoracic borders and dorsal line. The remaining two show both of these markings very well, but differ from each other in minor particulars. As the species is rare in American collections I have prepared the accompanying figure, which will give some idea of the color variations exhibited even by a small set. This species is known from Northern Alaska, the Nelson and Churchill Rivers and from Arctic Siberia southward to the Amur, according to Dr. Hamilton, from whose valuable paper (Trans. Amer. Ento. Soc., xvi, p. 88 *et seq.*) much of the distribution herein quoted is derived.

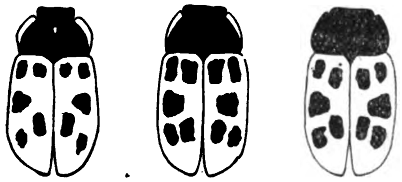


FIG. 1.

Serropalpus barbatus Schall.

One specimen occurs "from Maine to Alaska, Central and Western Europe, Western and Eastern Siberia." (Hamilton.)

H. F. WICKHAM, Iowa City, Iowa.

A Peculiar Seed-Like Case-Worm from the Grand Canyon.—While collecting in the Grand Canyon, July 8 to 11, 1892, the members of our party frequently found themselves covered with numbers of very small, thin, seed-like bodies, which became attached to their arms, hands, clothing, and faces. Examination proved these to be the cases of a very small larva, which lived within. They were afterward observed to be very common on the narrow-leafed willows (*Salix* sp.), a round-leafed species of leguminous tree, and on many, other plants. They were usually found on the edges of leaves, the case being attached thereto by a few extremely fine strands of silk. They occurred especially on the *Salix*, and were found at 2500 feet and more below the rim.

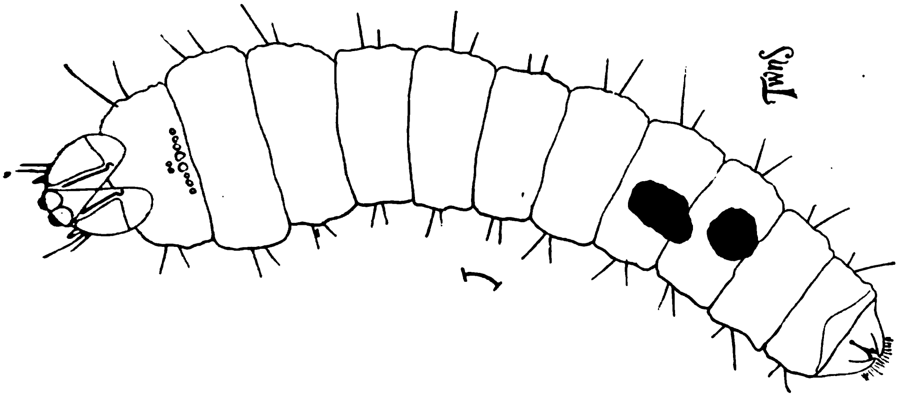


Fig. 2.—Larva, dorsal view—much enlarged. (Hair line shows natural size.)

An examination of this larva proves it to be lepidopterous. It has not been bred, but the description of the larva and case given below, together with the figures, will serve to identify it. It is peculiar as exhibiting no trace of legs or prolegs, yet it is unmistakably lepidopterous.

Description of Larva.—Body 13-jointed, whitish, very sparsely clothed with weak hairs; head and second segment with anal hooks, somewhat rufous. Head narrower than second segment, a little more than one-half as wide, subcircular in outline from above, widely and deeply notched behind; two small approximated simple eyes on extreme outer anterior edge of lateral dorsal plates of head just back of antennæ, the anterior one slightly larger than the posterior. Antennæ small, short, 3-jointed; first joint stout, a little longer than wide, with terminal bristles on outer edge; second joint very small and short; third joint a little narrower and longer than second, coming to a point at tip. Mandibles stout, narrowed and twice-notched

(3-toothed?) apically. First pair of maxillæ 3-jointed, joints about equal in length, basal joint stoutest, second and third joints decreasing in width; two pairs of palpi springing from inner side of basal joint, these palpi apparently also 3-jointed, joints of equal length, basal stoutest, second and third successively narrowed. Second pair of maxillæ with one pair of palpi, these palpi apparently 2-jointed, first joint moderately narrow, terminal joint elongate, bristle-like, tapering to a point; spinneret 3-jointed, joints sub-equal in length, basal joint stout, terminal joint pointed. Second segment corneous, with a transverse row of about eight roundish markings near posterior margin, and a median pair just anterior to row. Other segments fleshy, the integument of all segments except head microscopically warted, in the present alcoholic specimen much wrinkled, especially on third segment; third segment somewhat wider than second, fourth a little narrower, segments 5 to 10 about same width, 11 to 12 nearly as wide; segments 2 to 12 subequal in length. Thirteenth or anal segment narrowed, shortened, longitudinally bifid on the median line posteriorly, fur-

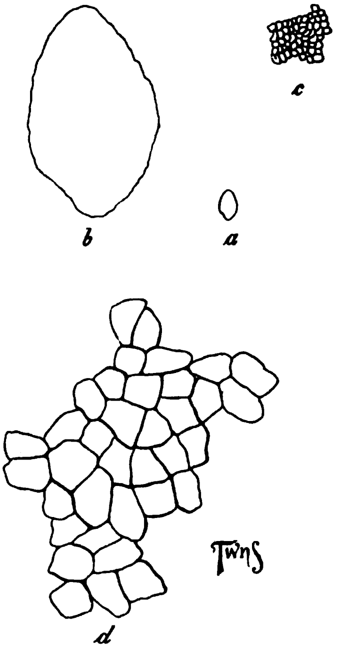


Fig. 3.—*a*, case—natural size; *b*, case—enlarged; *c*, portion of case—enlarged; *d*, portion of case—greatly enlarged.

nished with a pair of curved claw-like corneous hooks springing from sides of ventral surface, their tips closing on each other posteriorly. (Ninth and tenth segments each with a black circular or oblong contained body.) Spiracles showing on eleventh and twelfth segments as small nearly circular openings about the middle of segment near lateral margin, not apparent on other segments. No indication of true thoracic legs or of prolegs.

Length of larva (slightly curved as in drawing), 2⅜ mm.; width of third segment (second from head), about ⅜ mm.

Description of Case.—Case is small, seed-like in shape, very flat and thin, a little longer than wide, pale brownish in color, composed of two thin layers sub-oval in outline, glued together on edges, narrowly separated or free at one end, the larva living between the layers. Under the microscope a single layer presents a reticulated structure, appearing as if uniformly made up of very small irregular pieces of nearly equal size. It is apparently composed of vegetable tissue, probably very minute fragments of leaves.

Length of case, about 3½ mm.; greatest width 2 mm., or hardly more.

C. H. Tyler Townsend.

Entomological News.—At the meeting of the American Association of Agricultural Colleges and Experiment Stations held in New Orleans, Nov. 15 to 18, Chairman Lawrence Bruner, of Nebraska, and Secretary F. M. Webster, of Ohio, of the Entomological Section, were reelected for another year. But few entomologists were in attendance at the meeting, most of the Station entomologists seeming to prefer the Association of Economic Entomologists for the presentation of papers in reference to their work. The report of the Chairman of the Section of Entomology, Prof. Lawrence Bruner, was read by Prof. Osborn. The report largely consisted in a statement of the equipment of the Station entomologists as a whole, to which was added a statement in detail of the entomological equipment of each station having an entomologist. The report showed that while some of the stations were well equipped with laboratory, insectary, and other requirements for work, yet there were many stations which had not given entomologists proper equipment. Some of the Station entomologists lack room for laboratory, others library, and many, microscopes. Valuable results of a practical as well as a scientific nature are rarely attained without proper apparatus, and the Station entomologists need something more than jack-knives with which to carry on their work.

It is gratifying to learn of the advancement being made by many of the entomologists of the experiment stations. Prof. H. A. Morgan, of Louisiana, and Prof. Popenoe, of Kansas, who were formerly entomologists and horticulturists of their respective stations, have, upon their urgent request, been made entomologists of their stations only. This is a step in the right direction.

Prof. John B. Smith will have charge of the entomological part of the biological exhibit of the office of experiment stations at the World's Columbian Exposition.

Howard Evarts Weed, of the Mississippi Agricultural College is making a special study of North American Myriopods, and would be glad to exchange insects of any order for Myriopods of any locality, especially the west. His address is Agricultural College, Mississippi.

Prof. C. H. T. Townsend is preparing a monograph of North American Tachinidæ, and desires material in this family from any locality, especially bred specimens. His address is Las Cruces, New Mexico.

A recent issue of *Psyche* says: "Entomologists everywhere will regret to hear that the serious illness which has, for the past two years, incapacitated Dr. H. A. Hagen, renders it improbable that he will be able to do any further work. Dr. Hagen has had charge of the collections of insects in the Museum of Comparative Zoology at Harvard University since Oct. 12, 1867, and during this long period of twenty-five years has applied himself with entire devotion to the interests of the department. The scientific value and present excellent condition of the collections are the result of his faithful and disinterested work. Recently the department has been placed in charge of Mr. Samuel Henshaw."

Dr. M. C. Cooke, the well-known English mycologist, has brought together an account of the fungi parasitic upon insects in a volume recently published by the Society for Promoting Christian Knowledge (London, 1892).

We learn from *The Entomologists Monthly Magazine* that Mr. Oswald Latter reported at a recent meeting of the London Entomological Society that the moth *Dicranura vinula* produces, probably from the mouth, a solution of caustic potash for the purpose of softening the cocoon.

An interesting summary of the value of entomological study has been sent out by Mr. James Fletcher in the report of his Evidence before the Committee on Agriculture of the Canadian House of Commons.

PSYCHOLOGY.

Vision in a Young Girl Six Years of Age, Operated Upon for Double Congenital Cataract.—M. Grafé has published in the *Revue Scientifique* July 16, 1892, an interesting account of an operation for double cataract, performed by M. Bribosia upon a blind girl 5 years of age, and discusses, in the same paper, some questions of sight psychology. This reminds me of a similar operation performed by myself several years ago upon a young girl 6 years old, born with a double white cataract. Some notes of that operation, which I have kept, will perhaps be of use to M. A. Grafé in the researches he has undertaken in a new field.

What are the sensory impressions and emotions of a person born blind when the veil which has hidden from him the marvellous world is suddently rent? Would he, at first sight, see, as has been taught, objects reversed, in consequence of the crossing of the rays of light from the object before their contact with the retina? Would he have intuitively an idea of distance and of the third dimension of matter, or would this idea be gained by observation and experience?

In order to succeed in solving the problems of optical physics and visual psychology, M. A. Grafé arrived a little late after the operation by M. Bribosia. I had opportunities in the case of the child 6 years of age, more advantageous for studying the curious phenomena which took place, not only during the operation, but also during the dressing of the wound and the first exercise of the newly acquired sense.

The following are the notes of the operation:

Julie D. had a double white congenital cataract at the age of 6 years. She perceived less and less from infancy the light of day, even after the local use of belladonna. Being intelligent, she had acquired a variety of knowledge from conversation. Touch and hearing had become very sensitive, and her memory was excellent.

I operated upon both eyes at the same time, as was my custom with double cataract in old people as well as young. But, in order to avoid a sudden flood of light, I operate always in a slightly darkened room; and before attending to the second eye, I hermetically seal the first with a simple bandage. The dressing of the wound for the first few days is done in the same manner in a similarly darkened room.

When I allowed Julie D. for the first time to remove the bandage from her eyes she had a slight sensation of dizziness, which made her put her hands to her face. Then she saw at a little distance objects which she recognized by their shape; a coffee-mill, my hands, knives, forks, a plate, a cup, a watch, a handkerchief, etc., the forms of which she had become familiar with through touch during her long blindness. But she could not distinguish color. She would make hap-hazard guesses at red, green, blue, and yellow, but could sometimes recognize black and white. I was anxious to know her first optical impression as to the position of objects, whether they appeared right or reversed. With this idea in mind I showed her, first of all, a coffee-mill, held at the distance of a meter from her, and said, "What is this?" "My coffee-mill," said she without hesitation. "How do I hold it, with the drawer on top or on the bottom?" "It is below, as it ought to be." Thinking that the child was answering in accordance with her preconceived notions contrary to her first visual sensation, I showed her a knife fixed vertically by two threads to a sheet of white paper, and asked her to show me with her hand where was the handle of the knife, at the top or the bottom of the paper. She pointed immediately with her right hand to the handle, saying: "It is there, at the top." This was correct.

I did not indulge my scientific curiosity further at that time. At the second and third interviews which took place the sixth and seventh day after the operation, Julie was no longer deceived as to colors, but she still imagined as she had at first, that everything she saw was within reach. Space, height and volume did not as yet exist for her. However, she appreciated perfectly the distance of sounds. When objects were held for her at less than a meter's length, she would instinctively draw back, feeling, as she said, that they would strike her eyes. As to everything she saw that was at more than arm's length, they all seemed ranged on the same line, that is, all seemed equally distant. But this illusion did not last long. The sense of touch had given her such just ideas of the form, the size, and the different dimensions of buildings, persons and the objects in the midst of which she had lived, that ideas of perspective and appreciation of distances were speedily acquired.

At the end of fifteen days she said she had almost forgotten that she had ever been blind.

Had she, in the presence of what we call the wonders of nature, the flowers, the trees, the monuments, the country, the storms, the sky with its myriad stars, the sun and the moon, that awakening of the imagination roused by a spectacle as magnificent, as unexpected, which expresses itself in an ecstatic admiration? She was astonished at all, but she admired nothing. Had she dreamed, perhaps, during that long night of six years more and better things than the realities which unfolded themselves before her eyes?

It is a fact that the persons who have lost their sight, and recovered it through an operation, have shown more pleasure at seeing again their relations, their friends, and their coffee-mills than did Julie D. at seeing for the first time all the objects of which she could have had only a feeble and imperfect idea gained either through the sense of touch or from descriptions given her by others.—H. Boëns, Revue Scientifique, Oct. 29, 1892.

ARCHÆOLOGY AND ETHNOLOGY.

Area and Population of European Countries.—M. E. Levasseur, in a communication to the Academie des Sciences on March 21, 1892, calls attention to the diversity usually to be found in statistics of area and population in standard works of reference. Considering only such high class publications as "Die Bevölkerung der Erde," the "Almanach de Gotha," and the "Statesman's Year-Book," he points out that diversity does not necessarily convict any of error, as the approximation to the exact figures may be arrived at in different ways; that, in fact, absolute agreement in statistics is a sign that they have been copied by one writer from another. In some cases the areas of countries are officially derived from cadastral surveys, which, as a matter of fact, often do not include the whole land and water area of a country, geographers not being agreed as to what water areas should be reckoned along with the land. In other cases official or semi-official measurements are made on large-scale topographical maps, and the degree of approximation must vary with the scale, and with the technical skill of the computor. Some countries are content with measurements or estimates made by individuals, such as those of Strelbitsky and of Perthes' Institute. The calculation of population is still more uncertain, being dependent on census returns (themselves imperfect), calculated to any given intermediate date by estimates derived [illegible] registers of births, deaths, immigration and emigration. In a ta[illegible] brought down to the end of 1890 M. Levasseur gives a conspectus of the area, population, and density of population of the countries of Europe, classed in four groups, as follows:

	Inhabitants.	Area, sq. m.	Density per sq. m.
Western Europe.........	87,100,000	352,300	247
Central Europe...........	93,609,000	464,400	200
Southern Europe.........	71,826,000	557,800	130
Eastern Europe...........	98,000,000	2,106,500	47
Northern Europe.........	9,100,000	378,000	23
All Europe.................	359,635,000	3,859,200	93.1

Notes as to the various estimates are appended; those relating to the German Empire may be cited as an example. The "Bevölkerung der Erde" in 1872 gave the area as 207,816 square miles; in 1874 as 207,935; in 1876 as 207,943; in 1878, as in 1880 as 207,883; in 1882 as 207,899; in 1891 as 207,861; while Strelbitsky's measurement is 208,008, and that adopted in the tables from the "Statistisches Jahrbuch für deutsches Reich" for 1891 is 207,929 square miles.—Proceeds. Roy. Geog. Soc., July, 1892.

A Measure of Civilization.—Dr. Lamborn suggests that the proportionate length the artist gives the face or head to the body might be considered a measure of civilization. He finds that the late Spanish artists give 10½ faces to the height. Dürer 10 to 1. Earlier Spanish artists 9 to 1. The measurements of a number of wood cuts of the Fifteenth Century run 5½ to 1 and 6½ to 1. The Mexican images are 4 to 1, 3½ to 1, and 3 to 1. The gold figures of Peru make the head larger than the body. (Lamborn's History of Mexican Art.)

MICROSCOPY.[1]

On the Restoration of Osmic Acid Solutions.—The osmic acid so valuable to the histologist as a fixing reagent, is known to the chemist as osmium tetroxide, $Os\ O_4$, and is one of the series of osmium compounds with oxygen. It is readily reduced in the presence of an organic substance, giving up two atoms of oxygen and forming the deutoxide, $Os\ O_2$. This is the well-known black powder so familiar in specimens killed in any of the fluids into which osmic acid enters. Osmium tetroxide affects fatty substances first, and these are the substances that most readily undergo oxidation. Prolonged exposure to the action of the tetroxide blackens the tissue so that it is useless for histological purposes.

In preparing stock solutions of osium tetroxide the greatest care must be taken to exclude organic matter, even acetic acid in the quantity called for in Flemming's stronger fluid, is liable to cause the reduction of the tetroxide. A trace of impurity in the distilled water sooner or later produces the fatal blackening, while a solution made with pure water will keep indefinitely in the light. Let but a trace of dust fall into the bottle and reduction will take place to some degree.

During the summer of 1892, at the Marine Biological Laboratory at Woods Holl, Mass., a large number of solutions were treated with peroxide of hydrogen, $H_2\ O_2$, and different investigators tested them with uniformly good results. The restored solutions acted in the same manner as the fresh solutions, and produced the same results; the only noticeable difference was a gradual weakening of the solution, as would naturally be expected. Specimens overblackened by the action of the peroxide were rendered colorless without perceptibly changing the character of the tissue, and a few experiments were made to determine whether the bleaching with peroxide could be so controlled as to leave certain tissues blackened while others were cleared. This quantitative bleaching with peroxide yielded no very good results in the few experiments made, but enough was accomplished to warrant further attempts.

The chemistry of the restoration and the bleaching further demonstrates that no injurious factor enters into the result as is shown by the following equations:

---

[1] This department is edited by C. O. Whitman, University of Chicago.

$Os\,O_4$ + organic substance = $Os\,O_2$ + oxidized organic substance.
$Os\,O_2 + 2H_2O_2 = Os\,O_4 + 2H_2O$.

That is, in bleaching a tissue, the $Os\,O_2$ is converted into $Os\,O_4$, and water is formed, with which the tissue is already saturated.

To restore 100 cc. of a 1% solution of osmium tetroxide requires from 10 to 20 drops of fresh peroxide of hydrogen, and clearing goes on better in full sunlight. To bleach tissue with peroxide requires about the same amount in 100 cc. of water, and the bleaching takes place better in the sunlight also. The amount needed cannot be stated with any more precision because the peroxide loses its strength somewhat with age. The peroxide made by the Oakland Chemical Co., 54 South Avenue, New York, is more stable and keeps better than many of the preparations in the market.—C. L. Bristol.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Geological Society of America.—The Fifth Annual Meeting was held at Ottawa, Canada, on December 28, 1892, and following days. The following papers were read: Notes on the Early Palæozoic Sponges, Sir J. William Dawson, Montreal, Can.; Notes on the Devonian Formation of Manitoba and the N. W. Territories, J. F. Whiteaves, Ottawa, Ont. The object of this paper was to show the relationship of Devonian formation of Manitoba and the N. W. Territories with that of Northern Europe. In Manitoba the Stringocephalus zone is remarkably well developed and holds a rich fauna, whereas in the Mackenzie River district, most of the fossils so far collected seem to be from the Cuboides zone. On the Coals and Petroleums of the Crows's Nest Pass, Rocky Mountains, A. R. C. Selwyn, Ottawa, Ont.; On the Geology of Natural Gas and Petroleum in Ontario, H. P. Brumell, Ottawa, Ont. A brief résumé of work done in gas and oil explorations in Ontario, and dealing with the geological evidence adduced from record of wells sunk. Including also a short account of the geology of Southwestern Ontario. Some Features of the Phosphate Bearing Rocks of Ottawa County, P. Q., Elfric Drew Ingall, Assoc. Royal School of Mines, Eng. (Introduced by J. B. Tyrrell.) This was a preliminary paper, based upon field observations, discussing the phenomena exhibited by the Apatite deposits and their associated rocks in their bearing upon the question of the probable mode of formation of these deposits. Some Maryland Granites and Their Origin, Charles Rollin Keyes, Des Moines, Ia. A brief sketch of the granite-rocks of Maryland, with a summary of the reasons for regarding them as eruptive in origin. Epidote as a Primary Component in Granites, Charles Rollin Keyes, Des Moines, Ia. Occurrences of the mineral in certain granites regarded as eruptive described, the evidences of its original nature explained and its associations with the closely related Allanite considered. On the Laurentian of the Ottawa District, Robert W. Ells, Ottawa, Ont. The paper briefly reviewed the work of the late Sir Wm. Logan in this district, forty years ago, and discussed the structure of the calcareous portion of the system, more particularly as regards the relationship of the crystalline limestones to the underlying gneiss; with a brief statement of the several kinds of intrusive rocks which penetrate both the gneiss and limestone, and their apparent influence upon the occurrence of the economic minerals, such as graphite, apatite and mica. The Contact of the Laurentian and Huronian North of Lake Huron, Robert Bell, Ottawa, Ont. The line of contact between the Great Huronian Belt to the northward and the Laurentian area to the southward was traced from near Killarney on Lake Huron to its intersection with the Ottawa River. The two sets of rocks in this region were described with regard to their structure and their relations to one another. The nature of their contact here and in other instances in Canada was described in connection with the question of the conformability or otherwise of the two systems. Reference was made to the extraordinary development of quartzite in the LaCloche region, to certain forms resembling fossils lately discovered by the writer in the Huronian rocks of the vicinity, to the greenstone masses and dykes, to the nature of the granites and to other points in connection with the geology of the district. The marked dependence of the physical geography upon the phenomena of crystalline rocks of the region was likewise pointed out. The Archæan Rocks West of Lake Superior, W. H. C. Smith, Ottawa, Ont. (Introduced by R. W. Ells.) This paper gave a brief description of the rocks and their distribution between the Lake of the Woods and Lake Superior north of the International boundary and referred to some of the theories of origin and structure of the various members of the Archean system and to the iron ores and gold-bearing rocks of the region. On the Archean of Sudbury Mining District, Alfred E. Barlow, M. A., Geological Survey Department, Ottawa, Ont. This paper related in detail the various phenomena in connection with the contact between the Laurentian and Huronian to the northeast of Lake Huron, with a discussion of the origin and relative age of each, based on these observations. Notes on Cambrian Fossils from the

Selkirks and Rocky Mountain Region of Canada, Henry M. Ami, Ottawa, Ont. This paper was based mainly upon a collection of Lower and Middle Cambrian fossils made by the author in the summer of 1891. It contains notes on some eight species of Lower Cambrian (Olenellus zone) fossils from the gray, glossy and calcareous schists and limestones of the entrance to the Selkirks, some two miles west of Donald, British Columbia. The latter part of the paper dealt with the forms met with in the Middle Cambrian of Mount Stephen in the Rocky Mountains, near Field, B. C., where the terrane is highly fossiliferous. Upwards of twenty species have been recorded from this locality, many of which are very interesting and well preserved. On the Potsdam and Calciferous Terranes of the Ottawa Paleozoic Basin, Henry M. Ami, Ottawa, Ont. The stratigraphical, lithological and paleontological relations of the Potsdam and Calciferous terranes, as seen and known in the Ottawa palæozoic basin and elsewhere were discussed in this paper; also the reference of these two terranes to the Cambro-Silurian or Ordovician Epoch instead of to the Cambrian Epoch, inferred from the internal evidence. The Criteria for the Recognition of Separate Ice Epochs, R. D. Salisbury, Chicago, Ill.; Note on the Geology of Middleton Island, Alaska, George M. Dawson, Ottawa, Ont. This short paper was devoted principally to the description of a boulder-clay or till from Middleton Island, which is found to contain some marine fossils. Eskers Near Rochester, N. Y., Warren Upham, Somerville, Mass. The Pinnacle Hills, a very remarkable esker series in the southeastern suburbs of Rochester, were described and attributed to deposition by a glacial river flowing between walls of ice and open above to the sky. Their material, which is shown to have been englacial, is chiefly gravel and sand, but also comprises in some parts very abundant and large boulders, some of which are lified 200 feet or more above their sources within a few miles on a nearly plain country. Similar explanations are also applicable to other eskers in Pittsford, several miles farther southeast. Comparison of Plistocene and Present Ice-Sheets, Warren Upham, Somerville, Mass. The Plistocene ice sheets of North America and Europe were compared with the now existing Malaspina, Greenland, and Antarctic ice-sheets, as to their areas, surface slopes and probable thickness, rates of erosion and ablation, subglacial and englacial drift, and manner of deposition of various drift formations. The Malaspina glacier, or ice-sheet, covered on its wasting borders by much drift and growing forests, is believed to afford explanations of forest beds between deposits of till, and of the peculiar drift accumulations named drumlins, both being attributable to stages in the general recession of the North American ice-sheet when increased snowfall and onflow of the ice slackened its retreat or caused it temporarily to re-advance. Under this view, the Ice-Age seems probably to have comprised only one great epoch of glaciation, with moderate oscillations of the ice-front, and to have been geologically brief. Plistocene Phenomena in the Region Southeast and East of Lake Athabaska, Canada, J. B. Tyrrell, Ottawa, Can. The paper was the result of an exploration conducted by the writer during the past summer in the hitherto unexplored region lying southeast of Athabaska Lake and north of Churchill River. The region has some strongly marked glacial features. The writer disdiscussed the striation and character of the rock surfaces, the occurrence of till, drumlins, kames, and other glacial phenomena. Some high-level beaches, terraces, and other post-glacial deposits were also noted. Notes on the Glacial Geology of the Northeast Territories, A. P. Low, Ottawa, Ont. A short account of the geography and surface geology of the western water-shed of Labrador Peninsula, derived from explorations on the Rupert, East Main, Big, Great Whale and Clearwater Rivers, and along the east coast of Hudson Bay. Notes on the Gold Range in British Columbia, James McEvoy, B. A. Sc., Ottawa, Ont. (Introduced by H. M. Ami.) A short description of the topography of the Gold Range and part of the adjoining Interior Plateau country, with notes on the glacial geology of the same. The Glacial Gravels of Glacier Bay, Alaska, Harry Fielding Reid, Cleveland, Ohio (Introduced by J. S. Diller). The Post-glacial Outlet of the Great Lakes Through Lake Nippissing and the Mattawa River, G. Frederick Wright, Oberlin, O.; The Height of the Bay of Fundy Coast in the Glacial Period Relative to Sea Level, as Evidenced by Marine Fossils in the Boulder Clay at Saint John, New Brunswick, Robert Chalmers, Ottawa, Ont. Description of locality, area and thickness of boulder-clay. Divergent striæ on underlying rocks. The materials of the boulder-clay from the north. Intercalated stratified portions and their fossils deposited in the sea. Sections at Fern Ledges and Negrotown Point given. The conclusions are that the climate was Arctic or subarctic; that the boulder clay here was formed by a number of successive accretions in a zone of oscillation of the ice-front, and that its upper portion at least was thrown down when the lands stood 100 to 200 feet below its present level. On Certain Features in the Distribution of the Columbia Formation on the Middle Atlantic Slope, N. H. Darton, Washington, D. C. This paper was a description of relations indicating an interval of erosion between the depositions of the high-level and low-level portions of the formation, beginning in Southern Maryland and gradually increasing northward to New Jersey. A Geological Reconnoissance in the Central Part of the State of Washington, Israel C. Russell, Ann Arbor, Mich. The region traversed embraces about 10,000 square miles in the arid region east of the cascades and drained by the Columbia. The reconnoisance was made for the purpose of learning how far the conditions there existing favor the project of obtaining artesian water for irrigation. The following is a syllabus of the paper.

Geography of the region explored.
Geological formations.

Crystalline rocks.	Tertiary.	Glacial records,	Pleistocene.
Kittitas system.		Lake Lewis,	
Columbia lava.			
John Day system.			

Geological structure. Existing lakes. Artesian water supply.

The Abandoned Strands of Lake Warren, Andrew C. Lawson, Berkeley, Cal. The strands of Lake Warren, on the north side of Lake Superior, up to an elevation of 1200 feet above sea-level are post-glacial. It was not an ice-dammed lake. There was an outlet northward corresponding to one of its higher stages. A post-glacial depression of Central Canada whereby the James Bay slope was covered with marine sediments to a present altitude of 450 feet above tide and only 150 miles distant from Lake Superior is correlated with the maximum fullness of Lake Warren, and the subsequent uplift is correlated with its subsidence. The strand lines show no evidence of deformation. In the absence of ice dams and of a gorge of permanent drainage, the Level of Lake Warren could only have been lowered by epeirogenic depression along its southeastern margin, *i. e.*, in the region south of Lakes Huron and Michigan, which depression is thus coeval with the post-glacial uplift of central Canada. High terraces and beaches are known to extend along the north side of Lake Huron from Sault St. Marie eastward and they are reported on the high lands of the Peninsula of Ontario; so that Lake Warren must have been the greatest of the known Quaternary Lakes. Its area is roughly estimated at 150,000 square miles. The Importance of Photography in Illustrating Geological Structure, R. W. Ells, Ottawa, Ont. In connection with this paper was shown a series of large photographs by Topley, taken under the direction of the writer, showing more clearly the mode of occurrence of the apatite in the deposit of the Buckingham and Lievre district, as well as the relations of the intrusive apatite-bearing rocks to the surrounding gneiss. Two Neocene Rivers of California, Waldemar Lindgren, Washington, D. C. It was the purpose of this paper to briefly indicate the direction and grade of the *principal forks* of the Neocene equivalents of the present Yuba and American Rivers. These streams now drain an area in which many important Neocene gravel deposits are located, and to trace the old water courses is of the highest importance in order to successfully open and mine the auriferous channels. The results recorded here have been reached during the course of the investigation of the Gold Belt carried out under the direction of Dr. G. F. Becker, by the U. S. Geological Survey.

The geological events related to the accumulation and covering up of the Neocene channels were briefly sketched and the different systems of channels described. The fact was accentuated that the Neocene rivers closely correspond to those of the present day in the extent of their watersheds, although by no means always in the direction of their principal forks. A short statement was given of the work previously done in the same field by other investigators.

The course of the Neocene Yuba and American Rivers was described, by the aid of a map, on a small scale. In places where differing results have been obtained from those of other observers, or where new facts have been brought out, a more detailed statement was given. *Practical results:* The greater part of these Neocene channels is now covered by heavy masses of volcanic material and many of them, though auriferous, have not yet been opened for mining operations. The continuity of certain channels under the lava cap can be asserted and their approximate positions indicated; some of them, most likely to prove remunerative, but which have not yet been opened up, were mentioned; among them are the Blue Tent Channel, the Long Canyon Channel, and the Webber Creek Channel.

Boston Society of Natural History.—Dec. 21.—The following papers were read: Some New Experiments on the Absorption of Liquids by Aerial Parts of Plants, Mr. W. F. Ganong; The Abdominal Pouch of Butterflies of the Genus Parnassius, Mr. S. H. Scudder; Columnar Structure in Stratified Rock, Prof. W. H. Niles.

January 4, 1893.—The following papers were read: Account of Some of the Botanical Establishments of Europe (photographs were shown), Prof. W. G. Farlow; Application of the Microscope to the Study of Rocks (colored stereopticon views were shown), Dr. J. Eliot Wolff.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Biological Section.—Meeting of Dec. 12.—The following is a synopsis of the papers: On the Miocene Deposits of the White River, by Dr. J. L. Wortman; These deposits were arranged in three groups, *lower* or *Menodus* beds, *middle* or *Oreodon* beds, and *upper* or *Protoceras* beds. The *Protoceras* beds were regarded as in part contemporary with the *John Day* beds of Oregon. On the ileo-colic junction of Procyon lotor and allied Arctoids, by G. S. Huntington. The absence of cæcum in Procyon was noted as repeating the condition found in Hyæna and the Ursidæ. The provision for preventing return of contents of large intestine appears to consist in a series of constrictions in the terminal part of the ileum together with increase in the circular muscular fibres in these situations as well as at the ileo-colic junction itself. There is a complete absence of an ileo-colic valve. On the Origin of West Indian Bird Life, by F. M. Chapman. Conclusions from study of bird and mammal life were (1) distinctness geologically of Lesser from Greater Antilles; (2) independence of islands from mainland since the appearance of the present fauna; (3) original connection of West Indies to Central America by way of Jamaica; Central America at this time an archipelago created by passage leading from Pacific to Carribean Sea; (4) the older faunal forms of the West Indies represent survivors of the insular Tertiary species; (5) the newer forms are immigrants and become differentiated under new conditions of living. H. F. Osborn reported the discovery in the Miocene of South Dakota of a horned artiodactyle represented by male and female skulls and complete fore and hind feet. The female skull is comparatively hornless and proves to be identical with *Protoceras celer* Marsh. The male skull exhibits no less than five protuberances upon each side or ten altogether. Two of these upon the frontals and sides of the maxillaries are very small; the parietal, supraorbital and maxillary protuberances are very prominent and had apparently a dermal covering as in the giraffe. There are four toes in front and two behind as in the early Tragulidæ. The types were found by Dr. J. L. Wortman, and are in the recent collections of the Am. Mus. Nat. Hist.

BASHFORD DEAN, *Sec. Biol. Section.*

Natural Science Association of Staten Island.—Nov. 12, 1892.—The election of officers for the ensuing year resulted as follows: President, Walter C. Kerr; treasurer, Thos. Craig; recording secretary, Joseph C. Thompson; corresponding secretary, Arthur Hollick. A paper on Our Historic Landmarks, by Mr. Ira K. Morris, was read by title, and will be published as a "special" later on. Dr. N. L. Britton presented specimens of *Aspidium cristatum* (L.) Sw., collected by Mrs. N. L. Britton, near Oakwood. This fern is exceedingly rare on Staten Island, having been previously reported from but two localities, in one of which, the Clove Lake Swamp, it has been since exterminated.

Mr. Arthur Hollick read the following paper Upon Additions to the Cretaceous Flora of Staten Island.

At the meeting of January 2, 1892, I gave a preliminary account of the Cretaceous fauna and flora of the island so far as studied up to that date. At the meeting of March 12, the rediscovery of fossil leaves in the Kreischerville clays was recorded, and also the discovery of a large fossil leaf near Richmond Valley. At the meeting of September 10 the discovery by Mr. Heinrich Ries of fossil leaves in the Cretaceous clay at Green Ridge was recorded and since that time Mr. Wm. T. Davis has turned over to me a number of other specimens found by him in the clay at Kreischerville.

All this new material and such of the old as had not been critically examined has been the subject of careful study by me during the past few months with the result that there has been added at least thirty-eight species to our Cretaceous flora.

Most of them were known previously from the clays of Woodbridge or Amboy, N. J., but others have not before been reported from Eastern North America and we here have their first recorded occurrence in this region. Of these fourteen represent species new to science.

The specimens have all been shown from time to time at our meetings, and from these careful drawings have been made. The entire subject will be presented before the New York Academy of Sciences shortly, with full descriptions and figures of all the new species, which will be published in the Transactions in due time.

We have forty-seven species representing the flora of the Cretaceous formation on Staten Island. All the specimens from Tottenville, Richmond Valley, Princes Bay and Arrochar are in ferruginous rock of a concretionary character and are well preserved. Those from the clays of Green Ridge and Kreischerville soon began to disintegrate upon exposure to the air and are now mostly useless for purposes of identification.

Dec. 17, 1892.—A specimen of European "Gorse" or "Furze," sent by Dr. F. Hollick, was shown and the following memorandum read:

The accompanying specimen was obtained Nov. 10, from a small bush, about a foot in height, of European furze (*Ulex europœus* L.), which is growing wild on Ward's Hill, Tompkinsville. I first discovered it during the early autumn. To all appearances the plant is self-seeded, and is remote from any garden or cultivated ground. The only other vegetation in the vicinity is short stunted grass, so that the bush in spite of its small size, is a conspicuous object and has probably only escaped destruction by reason of its sharp prickly foliage. The locality is strikingly similar to the "commons" or "downs" where it grows in Great Britain. How it came here is a mystery, as the only other place where it is known to occur in America, so far as I am aware, is on the Island of Nantucket, where it was introduced about 1860, and has since spread to some extent. If protected and encouraged it would doubtless become established here and spread as it has done in the latter locality.

Mr. William T. Davis exhibited *Cecropia* cocoons which had been partly destroyed by woodpeckers, and read the following paper on woodpeckers and cecropia cocoons.

The caterpillars of the *Cecropia* moth spin their cocoons in a variety of places; occasionally on the flat side of a board fence, sometimes at the base of bushes such as the elder, and sometimes at the ends of swaying branches when the food plant happens to be a tree. The cocoons spun near the ground are often devoured by mice that gnaw through the silken coats to the edible pupa within. Specimens which had been thus destroyed were shown to this Association by Mr. Joseph C. Thompson on Dec. 12, 1889. Cocoons that are placed on tree branches are more safe from the attacks of mice, but are liable to be eaten by woodpeckers.

On January 14, 1888, I saw a downy woodpecker investigating a *Cecropia* cocoon in a white maple, the woodpecker thrusting its bill in and pulling it out of the cocoon quite frequently. After a while it flew to another cocoon a few feet away, but it being on such a small branch it was unable to successfully pick it open, as the branch swayed up and down. It was then plain what a great protection it was to the insects to place their cocoons near the branch ends, though no doubt they are sometimes killed by the swaying of these branches during a storm.

When the woodpecker was gone I cut the cocoon off and found a small hole on its side quite near the branch, where it was easiest to drill because the silken fabric gave way the least to the strokes of the bird. Cutting open the other side of the cocoon, I found that the pupa shell was sucked nearly dry of its contents.

The *Cecropia* cocoons, occurring commonly on white maples, are generally placed near the ends of the long drooping branches, and it will be seen from the foregoing that it is probably the safest situation afforded by the tree. Near my home there is a small white maple that has eight *Cecropia* cocoons on its branches, but only two of them, from their position, can be injured by a woodpecker.

If a woodpecker is successful in making a hole into a cocoon it is nevertheless sometimes disappointed at its contents. I have found a cocoon that contained the tough case of an Ichneumon fly pupa (*Ophion*), which had been drilled in the side by a woodpecker, and then abandoned, leaving the parasite unharmed.

Mr. Davis also submitted the following note:

The tawny thrush or Veery (*Turdus fuscescens*), has not been reported as nesting on the Island, but during the last spring and summer it was not uncommon at Watchogue. Several would often be heard singing at the same time, or be seen walking, hopping or running, for they do all three, along the wood paths and stopping by the way to turn over a countless number of dead leaves for the insects to be found beneath them. In every instance they frequented the edge of the close timber near to some open or half cleared ground, whither they often flew.

On June 26 I noticed a Veery carrying food in her bill, and was thus enabled, after a time, to discover a young bird perched on a log in a thick growth on the edge of a swamp. On July 10, with Mr. Walter Granger, of the American Museum, I heard many Veeries singing, but we were unsuccessful in finding a nest of the second brood.

It seems probable that this thrush has only been plentiful at Watchogue during the past summer, for just as close attention has been given to the district for a number of years, and yet only once before, namely in May, 1891, was a Veery heard singing.

Mr. Arthur Hollick read Notes on Staten Island Clays collected for the World's Fair.

Mr. L. P. Gratacap exhibited berries of *Smilax rotundifolia* and submitted a memorandum in connection with them.

Mr. Gratacap also exhibited drawings from microscopic examination of rocks to which seaweed had been attached, and read the following note:

The great quantity of rock used in constructing the roadbed of the Rapid Transit Railroad along our north shore has introduced upon the island a very representative collection of N. Y. Island rock, including mica schists, gneiss and granite. It serves the double purpose affording the local mineralogists an opportunity to study and collect feldspar, quartz and mica, with associated garnets and tourmalines and is a suggestion as well of the underlying reefs of archæan metamorphic masses upon which our own island is built, and our geological relationship with New York from whose ledges the rocks have been transported. Wherever these fragments have rolled down to the waters' edge or are so placed as to be inundated by the high tides, a very vigorous growth of the green filamentous seaweed (*Calothrix?*) has appeared. I am not sure that it is more marked than the similar growth over the traps, sandstones and shales which were the previous occupants of the shores of the Island, and which have been somewhat displaced from their intimacy with the waves and currents of the Kill van Kull by these later arrivals, but it does seem to me as if it had developed with interesting rapidity. The schistose flaky character of many or most of these fragments may have conduced to facilitate this luxuriant development; and where, as in the case of granite veins, the feldspar is coarsely brecciated, the interlacing lines of angular definition between the crystals offer a crevice for attachment. As a fact the lamellar fragments are more quickly invaded.

Placing under a microscope flakes of mica, feldspar and quartz, we can see the delicate filaments of the alga penetrating the films of the mica or occupying pits and irregular surfaces of the feldspar with distributed spots of green granules. Sometimes lacunæ or minute cavities, situated a little way within the edge of mica flakes, will be filled with the green spore-like groups. A few rude drawings show approximately some of the phases in this process of investment of the rock by the seaweed.

Cumulative effects have of late been much emphasized, and it is not unlikely that the alternating drying and swelling, from exposure to the sun at low and submergence at high water, of this alga may sensibly determine the duration, as a mass, of the more schistose or friable rocks, when the tiny extensions of this subtle enemy have effected an entrance within their substance.

The American Psychological Association—Met at Philadelphia, University of Pennsylvania, Tuesday and Wednesday, Dec. 27 and 28, 1892. On Tuesday, Dec. 27 there was a business meeting at which the nature of a permanent organization and other important questions will be discussed. The following papers were read:

Errors of Observation in Physics and Psychology; Prof. J. McK. Cattell, Columbia College; Experiments Upon Pain, Dr. Herbert

Nichols, Harvard University; Tactile Estimates of Thickness, Prof. Edward Pace, Catholic University, Washington; Some Experiments Upon the Æsthetics of Visual Form, Prof. Lightmer Witmer, University of Pennsylvania; Investigations of Reaction-times of Various Classes of Persons, Prof. Lightmer Witmer, University of Pennsylvania; History and Prospects of Experimental Psychology in America, President G. Stanley Hall, Clark University; Experimental Psychology at the World's Fair, Prof. Joseph Jastrow, University of Wisconsin.

Wednesday, Dec. 28.—Certain Phenomena of Rotation, Dr. Herbert Nichols, Harvard University; Note Upon the Controversy Regarding the Relation of the Intensity of the Stimulus to the Reaction Time, Prof. W. M. Bryan, University of Indiana; Minor Studies at the Psychological Laboratory of Clark University, Dr. E. C. Sanford, Clark University; Preliminary Notes Upon Psychological Tests in the Schools of Springfield, Mass., Prof. W. M. Bryan, University of Indiana.

Anthropological Society of Washington.—Dec. 20, 1892.—The program of exercises was as follows: Is Simplified Spelling Feasible? (Symposium.) Discussion by Prof. F. A. March, of Lafayette College, Hon. A. R. Spofford, Hon. Wm. T. Harris, Hon. Edwin Willits.

January 3, 1893.—The program of exercises was the following: Is Simplified Spelling Feasible as Proposed by the English and American Philological Societies? (Close of the Symposium.) Discussion by Prof. Lester F. Ward, Prof. Wm. B. Powell, Mr. James C. Pilling, Prof. Benj. E. Smith, Editor Century Dictionary; Dr. Charles R. G. Scott, Editor Worcester Dictionary; Mr. E. T. Peters, Major John W. Powell and Weston Flint. The discussion was closed by Hon. A. R. Spofford and Dr. Wm. T. Harris.—WESTON FLINT, *Secretary.*

The Biological Society of Washington.—Dec. 17, 1892.—The principal topic of the evening was What Should be the Scope and Object of a Biological Society? Introduced by Mr. B. E. Fernow. The following communications were read: Frost Freaks of the Dittany, Prof. Lester F. Ward; Notes on Peach Rosette, Dr. Erwin F. Smith; Destruction of Lichens on Pear Trees, Mr. M. B. Waite; Notes on Apple and Pear *Fusicladii*, Mr. D. G. Fairchild.

FREDERIC A. LUCAS, *Secretary.*

Indiana Academy of Science.—The eighth annual meeting was held in the Capitol Building at Indianapolis Dec. 28 and 29.

There was a large attendance of members and visitors. President J. L. Campbell, Wabash College, Crawfordsville, Ind., presided. The large number of papers entered made imperative the meeting of the Academy in three sections in the afternoon of the first day. These were so constituted that papers on mathematics, physics, chemistry and geology were read in one section; on botany in another; on zoology and anthropology in a third. On the evening of the first day the President delivered his address on The Independence of Liberal Pursuits. The following officers were elected for the next year: President, J. C. Arthur, Purdue University, Lafayette, Ind.; vice-president, W. A. Noyes, Rose Polytechnic Institute, Terre Haute, Ind., secretary, A. W. Butler, Brookville, Ind.; assistant secretary, Stanley Coulter, Purdue University, Lafayette, Ind.; treasurer, C. A. Waldo, De Pauw University, Greencastle, Ind.; auditors, Thomas Gray, Rose Polytechnic Institute, Terre Haute, Ind.; W. S. Blatchley, High School, Terre Haute, Ind. L. M. Underwood, De Pauw University, Greencastle, Ind.; and W. A. Noyes, Rose Polytechnic Institute, Terre Haute, Ind., were appointed program committee. The Academy decided to hold its spring meeting the third week in May in Parks County, Ind., closing with an evening meeting Friday at Terre Haute, Ind.

The following papers were presented: Notes on the Reproduction and Development of *Grinnellia americana* Harv., M. A. Brannon; Evidence of Man's Early Existence in Indiana from the Oldest River Gravels Along the White Water River, A. W. Butler; On the Construction of a Sensitive Galvanometer, Benj. W. Snow; Some Facts as to the Varying Conditions of Rock Deposits as Observed in the Hudson River Beds of Indiana and an Inquiry as to the Cause of the Same, Joseph Moore; A Simple Air Thermometer for the Determination of High Temperatures, W. A. Noyes; Tests of the Torsional Strength of a Steel Shaft, Thos. Gray; An Extreme Case of Parasitism, Robert Hessler; Exhibition and Explanation of a Geological Chart, Elwood P. Cubberly; Local Variations, C. H. Eigenmann; Botanical Field Work in Western Idaho, D. T. MacDougal; The Quaternion Treatment of the Motion of Two or More Bodies Under the Law of Gravitation, A. S. Hathaway; The Electrical Oxidation of Glycerin, W. E. Stone and H. N. McCoy; Notes Concerning Tests of the Purdue Experimental Locomotive, W. F. M. Goss; The Electrostatic Theory of Cohesion and Van der Waal's Equation, Reginald A. Fessenden; On Sulphon-pthaleins, Walter Jones; Quartz Suspensions, Benj. W. Snow; Observations on Glacial and Pre-glacial Erosion at Richmond, Indiana, Joseph Moore; A Modification of Grandeau's Method for

Determination of Humus in Soils, H. A. Huston and F. W. McBride; Experiments with and Phenomena of Vacuum Tubes, R. A. Fessenden; The Extraction of Xylan from Straw in the Manufacture of Paper, W. E. Stone and W. H. Test; The Electro-magnetic Inertia of a Large Magnet, Thos. Gray; The Determination of Chlorine in Natural Waters, W. A. Noyes; Some New Electrical Apparatus, R. A. Fessenden; Thiofurfurol and its Condensation Products, W. E. Stone and Clinton Dickson; On the Construction and Use of a Bolometer, B. W. Snow; On the Determination of Valence, P. S. Baker; An Application of Mathematics in Botany, Katharine E. Golden; On the Fertilization and Development of the Embryo in *Senecio aureus*, D. M. Mottier; Distribution of the North American Cactaceæ (by title), John M. Coulter; *Marchantia polymorpha*, not a Typical or Representative Liver-wort, L. M. Underwood; Notes Concerning Certain Plants of the Southwestern Counties of Indiana, John S. Wright; Spines and Epidermis of the Cactaceæ (by title), E. B. Uline; Preliminary Notes on the Genus Cactus, E. M. Fisher; An Auxanometer for the Registration of Growth of Stems in Thickness, Katharine E. Golden; The Apical Growth of the Thallus of *Fucus vesiculosus*, D. M. Mottier; Symbiosis of Orchidaceæ, M. B. Thomas; Notes on Pediastrum, W. L. Bray; The Genus Corallorhiza, M. B. Thomas; Notes on Root Tubercles of Indigenous and Exogenous Legumes in Virgin Soil of the Northwest (by title), H. L. Bolley; Notes on Archæology in Mexico, J. T. Scovell; Notes on the loss of the Vomerine Teeth with Age in the Males of the Salamander, *Desmognathus fusca* (by title), F. C. Test: Modern Geographical Distribution of Insects in Indiana (by title), F. M. Webster; New Species of Indiana Hymenoptera, reared at LaFayette, Ind. (by title), F. M. Webster; Description and Elevation of Mount Orizaba, J. T. Scovell; The Climate and Glaciers of Mounts Orizaba and Popocatapetl, J. T. Scovell; A Mite, Probably *Hypoderas columbæ*, Parasitic in the Pigeon, W. W. Norman; The Locustidæ of Indiana with Description of New Species, W. S. Blatchley; Early Stages in the Development of Cymatogaster, C. H. Eigenmann; Some Remarks Regarding the Embryology of Amphiuma, O. P. Hay; Some Structural Peculiarities of Pacific Slope Fishes (by title), A. B. Ulrey; Peculiar Death of an Oriole (by title), T. B. Redding; The Range of the American Crossbill (*Loxia curvirostra minor*) in the Ohio Valley, with Notes on its Unusual Occurrence in Summer, A. W. Butler; A Note on *Loxia curvirostra*, W. S. Blatchley; Notice of a Terrapin to be Restored to the Fauna of Indiana, O. P. Hay; A Migration of Birds and one of Insects, T. B. Redding: The South American Catfishes Belonging to

Cornell University (by title), E. M. Kindle; Notes on the Genus Lytta, W. P. Shannon; The Ichthyologic Features of the Black Hills Region, B. W. Evermann; Explorations in Western Canada, C. H. Eigenmann; Ancient Earthworks Near Anderson, Indiana, Francis A. Walker; The Work of the U. S. Fish Commission Steamer Albatross in the North Pacific and Bering Sea in 1892, B. W. Evermann; A Thermo-regulator for rooms Heated by Steam, J. C. Arthur; Archæology of Tippecanoe County, O. J. Craig; Some Indian Camping Sites near Brookville, A. W. Butler; Relation of Kings County Traps to those of Cumberland County, N. S., V. F. Marsters; The Traps of Red Head, N. B., V. F. Marsters; On Birds in Western Texas and Southern New Mexico (by title), A. W. Butler; An Account of Vegetable and Mineral Substances that Fell in a Snow Storm in LaPorte County, Jan. 8–9, '92 (by title), A. N. Somers; How a Tendril Coils, D. T. MacDougal; Remarkable Prehistoric Relic, E. Pleas; The Brun's Group of Mounds, H. M. Stoops; Some Points in the Geology of Mount Orizaba (by title), J. T. Scovell; Two-ocean Pass (by title), B. W. Evermann; The Blattidæ and Phasmidæ of Indiana, W. S. Blatchley; Forestry Exhibit of Indiana at the Columbian Exposition, Stanley Coulter; The Yolk Nucleus, J. W. Hubbard; Some Causes Acting Physiologically Toward the Destruction of Trees in Cities, J. C. Arthur; British Columbia Glaciers, C. H. Eigenmann; A State Biological Survey—a Suggestion for Our Spring Meeting, L. M. Underwood; The Mounds of Brookville Township, Franklin County, Ind., H. M. Stoops; How the Colleges could aid the Public Schools in Teaching Biological Subjects, W. W. Norman; Notes on the Flora of the Chilhowee and Great Smoky Mountains, Stanley Coulter; The Need of a Large Library of Reference in Cryptogamic Botany in Indiana—What the Colleges are Doing to Supply the Deficiency, L. M. Underwood; Exhibition of a Series of Grouse and Ptarmigan from Alaska, B. W. Evermann; Botanical Assemblies in the United States Announced for the Year 1893, J. C. Arthur; Development of Ovule in Aster and Solidago (by title), G. W. Martin; Remarks on Archæological Map Making (by title), A. W. Butler; The Lilly Herbarium and its Work, John S. Wright; Additional Facts Regarding Forest Distribution in Indiana, Stanley Coulter; Rotary Blowers, John T. Wilken; Some Effects of Mutilation on the Forms of Leaf and Sex of *Morus alba* and *Morus nigra* (by title), A. N. Somers; The Crawford Mound (by title), H. M. Stoops.

SCIENTIFIC NEWS.

What Is an Acquired Character?—I suppose that I am the person to whom Prof. Nutting refers (December, p. 1009) as "the member" who, at the Rochester meeting, "had the temerity to confess that he was not sure that he knew the exact nature of an 'acquired character.'" I have been strongly impressed with the feeling that argument against the position of Weismann and his followers is useless, from the method of these writers in explaining away whatever proofs of the hereditability of acquired characters one may bring forward. The definitions of an acquired character are themselves sufficiently vague and various, but the treatment of individual instances by the Neo-Darwinians seems to preclude the possibility of argument. Prof. Ward has well said that Weismann's "treatment of this point (hereditability of acquired characters) often borders on the dogmatic." The practice seems to be to use the definition as a stalking-horse to shield the philosopher from the onslaughts of his opponents. If he is driven into a corner it is easy enough to say that the character in question is not acquired, but that there existed a predisposition to it; and while he cannot afford any proof of the assertion and may not be able to bring forward any reason for it beyond its convenience as a method of escape, his opponent cannot dislodge him from his position. It seems to me, as I said at Rochester, that much of this argument is but a war of words; and Prof. Nutting has precisely indicated my own difficulties concerning it.

I have been growing plants for a single generation in soils of different chemical composition, the seeds having been taken from the same fruit. These plants show characteristic differences, and when the seeds from the different lots are sown in one soil the resulting plants show that some of the novel characters become hereditary for a generation or more. If I were to bring these experiments forward as proof of the transmission of acquired characters, my opponents would simply say, "Oh, well, these are not acquired characters; there was a predisposition to them."

I may remark here that an inexhaustible field for study of contemporaneous evolution is afforded by common cultivated plants; and if we are to consider acquired characters in the Darwinian sense, I fancy that no one could long be a horticulturist without becoming a confirmed believer in their transmission.—L. H. Bailey, Cornell University.

The Geological Survey of Alabama.—The Legislature four years ago reduced the tax rate, unwisely, as now appears, for it has caused the money in the treasury to run now about $200,000 short of what is needed to carry on the affairs of the State. When the present Legislature met and was confronted with this deficiency in the treasury, the first thought was to reduce the expenses of the State within the present income by retrenching in every direction. Accordingly a number of bills were introduced aiming to cut off everything that we could possibly do without. Among these bills was one prohibiting the payment of any money to the survey for the next two years, saving $15,000 on this item. Many of the members both of the House and of the Senate were disposed to support this wholesale retrenchment if by it the raising of the tax rate could be avoided; for the raising of the rate would be an unpopular measure as a matter of course, and would be made the most of by the enemies of the party in power. Upon closer examination it has become perfectly evident to every one that the tax rate must be raised, for all the retrenchment proposed and in any way possible will fall far short of remedying the trouble. But some of the members are afraid to vote for raising the rate without, as an offset, voting to cut down every expense in the State to its minimum. While it is not likely that the extreme measures at first proposed will pass, there may have to be some compromise that will cut off part of the sum usually coming to the survey. There is no one fighting the survey, for the sentiment is very favorable to us, but they may have to show that they have economized.—EUGENE A. SMITH.

Recent Deaths.—John Obadiah Westwood, M. A., F. L. S., honorary president of the British Entomological Society, died January 1. Prof. Westwood was born in Sheffield in 1805. He was educated at Litchfield and was appointed in 1861 to the professorship of zoology founded at Oxford by the munificence of the late Rev. F. W. Hope.

In 1855 the Royal Society awarded him one of the royal medals for his scientific works, and in 1860 he was elected to fill the place of the illustrious Humboldt as corresponding member of the Entomological Society at Paris. He wrote "Introduction to the Modern Classification of Insects," "Entomologists' Text Book," published in 1838; "British Butterflies and Their Transformations" in 1841, and a number of other works of a similar nature. The number of his memoirs on special groups of insects is large, and he introduced many important forms to the scientific record.

Prof. J. G. Joessel, of the University of Strasburg, is dead. He was born April 27, 1839, and was ordinary professor of anatomy.

THE
AMERICAN NATURALIST

VOL. XXVII. March, 1893. 315

THE QUANTITY OF HUMAN LIFE.

BY J. LAWTON WILLIAMS.

Compared with periods of terrestrial history the duration of a human life even at the very longest is exceedingly brief. In our own time only a very few people ever live to see their hundredth birthday, and the average age is now calculated on the basis of elaborate statistics to fall between thirty-three and thirty-four years.

It seems to be a prevalent opinion among unreflecting people, that the quantity of an individual life is expressed by the number of days and years recorded on his or her tombstone. That such an opinion is erroneous will be rendered evident by a little consideration. First of all, in estimating the quantity of human life, we must possess some well defined conception of what we mean by the term life. This point settled, we can proceed with some degree of certainty in our calculation. Whoever has devoted a little thought to the subject, cannot fail to be deeply impressed with the multitude and diversity of the factors which enter into the experiences of a life-time. There are the ever changing phenomena of the external world awakening and controlling the states of consciousness. There are the equally changeful individual activities perpetually giving rise to new internal changes. In other words, there is the physiological life utilizing the forces of nature, and making them subservient to the wants of the individual economy;

and, by its side, generating and directing its activities is its ever present companion the psychological life. Here then, we have a duplicate existence, extending over a finite period of years, incessantly changing from the time of its beginning, throughout the periods of growth, maturity and decay, and ultimately resolved, so far as human observation goes, into other existences of a lower order.

Life, then is an existence. It is an existence characterized by incessant changes, and those changes are the manifestations of force. Hence, disregarding all ontological questions, the quantity of life may be measured like any other force, by the product of its intensity into the time of its duration. Let us now consider the factors which enter into and control the intensities of human life. Subjectively considered, life is obviously made up of a series of conscious experiences; objectively considered, it is made of a succession of molecular and molar motions. To avoid too great complications we will consider it only subjectively, since the objective life has much in common with the motions of dead matter.

Hobbes has well said "it is almost all one for a man to be sensible of one and the same thing, and not to be sensible at all of anything." For instance the ticking of a clock continued unintermittently through days, months, and years, forms a rhythm in the conscious life which is equivalent to silence. Not until it ceases are we aroused to a consciousness of its former existence. The same is true of all familiar and oft repeated experiences. No matter how intense and vivid may have been the first appeal of an experience, sooner or later its reiterated occurrence establishes itself in the rounded and frictionless ruts of an indifferent consciousness. It might at first be inferred from this law, that for the conscious life to attain to its maximum intensity, it should experience the rarest stimuli; and those stimuli should be as intense as possible. There is a limit however, beyond which novelties fail to be impressive, and the over stimulated and flagging consciousness relapses into apathy and indifference. But as a general rule we may be guided by Hobbes' statement, and from its converse deduce the proposition, that the intensity of conscious life varies as the number and rarity of its experiences. But the number and rarity of its experiences depend upon a great variety of circumstances.

They depend upon the diversity of external conditions. They also depend upon the extent and acuteness of surfaces of contact, and the rapidity with which those surfaces are transported into new environments. Finally they will depend upon the stock of vitality of the individual. All these factors must be considered in estimating the quantity of the conscious life. The diversities of external surroundings are very great. Even in primitive communities, and amid the habitual isolations incident to a nomadic life, the differences in the attitudes and groupings of the objects of inanimate nature, and of the lower orders of animate nature, are ever stimulating the conscious life to new and intense experiences. Surprises, alarms, friendship, apathies, pleasures and pain are ever appealing in new and varied relations to the would-be slumbering sensibilities. But when we pass from the primitive condition of solitude to the later condition of society where the wide play of forces concerned in human interests is brought to bear in a multiplicity of combinations upon the individual life, the number of conscious experiences increases with the members of the community not in an arithmetical, but in a geometrical ratio. This holds up to a certain point when the maximum of conscious experiences during a given time is reached.

The limit is a subjective and not an objective one. It is determined by the capacity for reception of the individual. Amid the intricacies of modern civilized life that limit is speedily reached. Even the most capacious and versatile minds soon weary of the endless solicitations of the senses and the trains of ratiocination to which they give rise. The keen activity of such minds is rapidly dulled by the continuous impact of stimuli, and soon falls back upon the restful reiteration of former experiences. But even the repose of such reminiscences is disturbed by the jars and turmoils of inevitable environments, and the drowsy sensibilities are spurred on to renewed activities day after day so long as life continues. Thus it happens that the average life of the social individual is much more intense than that of the inhabitant of solitudes. The reason is, that the sociological stimuli affect us more than stimuli of equal or even greater intensity proceeding from inanimate nature, or the lower orders of animate nature. Society also engenders wide differences in the experience of its various members on account of financial, political and other differences. The humdrum life of the common laborer is much less varied, and, therefore much less intense than the life of the gentleman of affluence and leisure who diversifies his experiences by travel, letters, society and recreative sports.

The lavish distribution of cheap literature within the last quarter of a century has immensely augmented the differences in the quantities of living among people of the same social standing. It is not uncommon to find two men engaged in the same occupation one of whom cannot read or write, while the other is conversant with the widest questions of political and social progress. Literature thus tends to obliterate the quantitative differences of life arising from certain social accidents of birth, and places all men, so far as the intellectual consciousness is concerned, on pretty much the same level as quantitative experiences. Much more might be said as to the diversities of the external conditions, but this must suffice.

We now pass on to consider the surfaces of contact. Under this designation are included all the external integuments of the body as the skin, eyes, hair, and so on. For the sake of mathematical simplicity we will assume at present that equal surfaces of contact possess equal degrees of sensibility in two individuals during equal periods of time. Then if one person present twice as much surface of contact as another, that person will, other things equal, receive twice as many peripheral stimulations as the other. (We here assume that an equal number of stimulations come from every direction against the unit of the surface.) Now the surfaces of contact vary as the square of some lineal unit. Suppose the surfaces of contact be 4 and 8 respectively; then the linear units are 2 and 2.8+. But the masses and weights of the bodies whose surfaces are 4 and 8 vary as the cube of the linear units, or as

$2^3 = 8$ and $(2\cdot8+)^3 = 22\cdot4+$. Now in order that the individual with double the surface of contact may encounter twice as many stimuli as the other, when both are moving through their environment, it must move the same distance as the other. In moving such a distance however, it will perform not twice but nearly three times the amount of work that the other performs since it will transport nearly three times the weight. Thus, if the expenditure of muscular energy detracts from the stock of vitality, and hence dulls the keenness of the sensibilities, even though the surfaces of contact of the two individuals possess initially the same degree of sensibility by reason of that impairment, the larger animal would experience less than twice as much consciousness as the smaller. Viewed from another standpoint, the smaller animal could execute more than twice the velocity of the larger with equal expenditure of strength, (disregarding the resistance of the medium), and hence it would encounter more than an equivalent number of experiences.

It was here assumed that equal surfaces of contact conveyed equal quantities of sensibility in the two individuals, but it is well known to physiological psychologists that there are immense differences in the relative acuteness of the different sense organs in the same individual, and in the same sense organs in different individuals. The optical, auditory and tactile powers are quite variable. Probably the experiential products of all the other senses combined do not equal those which come through the medium of vision. It will thus be readily inferred that the extent of surfaces of contact is less important in relation to the experiences of the conscious life than their quality; and the movements of the individual tending to multiply experiences are less important than the movements of the environment. For example, an observer standing on a street corner in a great city, or riding in a railway coach at forty miles an hour, will gather more experiences than he would were he to run at the top of his speed in a deserted field. Doubtless he might experience a high degree of exhilaration at first, yet experience of effort would prevail. Such experiences like all other somatic feelings have a place in consciousness, but they certainly do not have that vivid and definite character which distinguish peripheral sensations. Moreover they must detract from the general vitality, and lower the tone of the higher orders of experience.

There can be no doubt that the stock of vitality, and the natural endowments of body and mind immensely transcend all the other differences hitherto considered. Not only do they give rise to differences in the intensity, but also in the duration of life. The vigorous, alert, and impressionable nature has a livelier consciousness of all that it experiences, responds more keenly to all its enjoyments, and resists more stubbornly the wracking and dissolution of conflict and disease. Hence such an individual lives longer and lives more. There are still other differences of a psychological character which give rise to still more important variations in the quantity of the conscious life. Owing to the absence of any standards in the higher fields of psychometric research, it is hard to discriminate between quantitative and qualitative differences. Yet viewed from a rational standpoint it cannot be doubted that different kinds of consciousness are quantitatively different, though there is no perceptible disparity in their relative intensities. That the untutored savage feels as intense gratification in the pursuit of his game, as the astronomer in the pursuit of undiscovered asteroids, cannot reasonably be doubted. But how totally different the quality of the feeling, and the psychological grounds upon which it is based! Where the thoughts and emotions are different in kind, this disparity is even greater. There are certain thoughts and emotions accessible to the few which are totally beyond and above the range of the average mind. Such thoughts as those of Laplace and Kant, and such emotions as those of Schiller, are of this order.

While it may not be easy to defend the position, yet we feel forced to believe that there are quantitative differences between such thoughts and emotions, and the stolid apathy, and gross materialistic conceptions of the mediocre mind.

Up to this point we have considered the conditions which modify the quantity of the conscious life in a general way. But the quantity of the life of every human being is subject to innumerable vicissitudes both accidental and periodic. While there is an endless influx of disturbing forces which augment or deplete the quantity of life at all times, yet there are certain periodic causes which promote recurrence of cycles of consciousness. Such are the alterations of day and night, the recurrence of the seasons, and the widely extended observance of days and customs. How much the quantity of life is temporarily augmented by the convivialities of Christmas and other commemoration days! Then there is a diurnal rise and fall in the conscious life. The morning with its vivid and buoyant sensations; the rising of the energies and their temporary lull at midday, and their slow descent with the descending of the sun. Then the twilight comes on with its calm reflections and feelings, succeeded by the serenity of sleep. But even here the pulse of consciousness rises and falls, summoned into being by the vague apparitions and muffled ounds of dreams. At length these increase in vividness and frequency, the pulse of consciousness grows more intense until we are again ushered into the hazy realities of another morning. Then there are the periodicities arising from the changing seasons.

To one who dwells during a period of years in the same place, the events which are repeated from year to year are much in excess of those which are variable. Hence the annual rhythms of consciousness are quite well marked. The conscious life throughout the time of its existence is subject to quite well defined periods of change. There are several striking analogies between the consciousness of infancy and that of extreme old age. Both are oblivious of details, apprehending only to the salient outlines and strong qualities of things. Both repeat and re-repeat simple things, the babe its lullaby, the old man his favorite story. The consciousness of old age is reminiscent because the powers are feeble, and reminiscences are paths of least resistance. Quite otherwise is the consciousness of youth and the prime of life. It is vigilant and aggressive, and ever seeking new combinations of experience. Not only is the quantity of the conscious life extremely varied in its different periods of development, but also in its quality. In early years and even far into the period of maturity the physiological activities prevail. Childhood and early youth are characterized by the aimless movements of spontaneity and the prodigal expenditure of physical force; later on the psychological life rises in importance and attains its maximum when the physiological life is on the wane. This continues until the decay of old age sets in.

A grander series of changes remains yet to be considered. This is suggested by the query, how does the quantity of human life existing on the globe at the present time compare with the quantity of the antecedent times? Whoever reviews the history of the race during the nineteenth century as related to its history in previous times will observe a tremendous acceleration in the rate of living, and a vast augmentation in the intensity of human life. Notable among the causes which have secondarily conspired to this end, may be mentioned the centralization of populations. Within a century, according to the London *Journal of Statistics* the relative populations of the country and city of England have changed sides. Up to about 1840 the rural population exceeded the urban. About that year they were equal, and ever since, the cities have had a constantly increasing majority. The same is true in general of other civilized countries. Facts like these tend to show that the society of modern life is becoming more consolidated, and hence the aggregate of human experiences is becoming increasingly intense from year to year. Among the primary causes which have brought about this consolidation, are the improved facilities of travel, commerce, and communication between mind and mind. Not only have they done this, but they are the indispensible conditions of an intricate co-operative existence. But these are only a few of the many factors which enter the problem of this augmentation of life. The differentiation of pursuits and the widely diversified products of human genius, all minister to the ever broadening possibilities of human experience. To-day the child under its teens is much more sophisticated than was its semi-savage ancestors of four-score years who lived only a few generations ago. Even the lower animals in the bustling communities lead a more varied life than primitive men, probably more varied than our contemporary the Fuegian, whose life is a monotonous ordeal of physical suffering, or the Esquimau whose days are passed in the unbroken solitudes of Arctic America. In view of these unprecedented changes, and the steady increase of population, it is but a step to the conclusion that the quantity of human life on the globe to-day is greater than ever before. In all probability the aggregate quantity of conscious life which has been experienced during the nineteenth century is far greater than the life experienced in any antecedent period of equal duration. Never was there a recorded time when the drain upon natural resources was so great as it is to-day. These resources are all turned either directly or indirectly toward the furtherance of human experience. Not only do these agencies of civilization add to the multiplicity of human experiences, but they also add to their pleasurableness. Thus undaunted by the clamors of pessimism we may firmly believe that the sum of human happiness is greater to-day than ever before.

The marked feature with which we are impressed in reviewing the evolution of human life, is its growing complexity. But by the very terms of a previous proposition, this signifies a growth in the quantity of conscious experience. All primitive life was simple and plain. Monotony was stamped upon its music, language, gesture, and the rounds of domestic, social and political life. The frequent repetitions of barbarian speech, and the sing-song tones of their music are in pitiable contrast to the sweeping climax and anti-climax of the civilized orator or opera singer.

The principle is of general application. All orders of experience are more varied in the civilized than in the savage state. Hence the quantity of life for each individual is greater, and the totality of human experiences immensely greater with the diffusion of civilization. We have now considered some of the factors which determine the quantity of human life. The final inquiry remains, how are we to live most? and how is the race to live most? Judging from the foregoing conclusions we would say in the case of the individual, that this end is insured by multiplying the number, intensity, and variety of his experiences. Spinoza had for a motto, "to live is to think.' Surely the quantity and quality of our thinking has much to do with the quantity and quality of our living, but from considerations already discussed, this utterance seems to be wanting in comprehensiveness. If this statement were true without qualifications, then he who thinks most lives most, but we have already seen that other experiences than those of thought have perhaps an equal degree of intensity, and involve an equal amount of living. Any conclusion which can be reached on this question is necessarily colored by personal prejudices, and cannot be set up as a general standard. To me, at least, he seems to live most who enjoys the greatest possible range of conscious experiences of the highest order, during the longest period of time. And the quantity of life seems to be truly greatest which embodies the fullest and highest expression of the attributes of the intellect, the emotions and the will.

Not where the experiences are confined to one of these alone, but where all three have equal sovereignty in the dominion of the mind. He seems to me to live less whose life embodies one or all of these in a less degree, or who has sullied their original purity with baser purposes and ends. Perhaps this may seem too ethical for a scientific statement but until that same ethical spirit shall more fully actuate the promoters of science, its highest beauty and usefulness cannot be completely realized. Even the best of us lead much more diminutive lives than our circumstances require. If we would but remember that it is as easy to think great thoughts as to think little thoughts, and feel great emotions instead of base and belittling ones, we might all enter into a largeness of life which far exceeds its present dimensions. But we must pass on to consider the question how can the race live most? One thing is certain, while all are permitted to think and feel and will, all cannot be brain workers. There must be doers as well. Society is so organized that no small part of its members must perform physical labor. This being the case, to realize the maximum of conscious life, there must be the greatest possible number of mental laborers, and the least possible number of physical laborers; and in each case the maximum of consciousness must be sought. Speculative as these views may appear yet they are substantiated by historical fact. To-day when the quantity of human life is greatest, the physical laborers effect most with the least effort, and the mental laborers are constantly diminishing that effort. So that were a given status of living to continue, the physical laborers would decrease, and the mental laborers would increase until finally equiblibrium should be attained.

Such equilibrium however, is indefinitely postponed by the constantly ascending standard of living. But as the standard of living ascends, all live more, and, since the physical laborers diminish and the mental laborers increase, the quantity of life is still further augmented. This would happen were the population to remain constant. But as the standard of life rises, the possibilities of existence increase, and the death rate diminishes. Consequently the population increases as the quantity of the individual life increases, and hence the total quantity of human life is augmented by both of these reciprocating factors. How great the quantity of human life may some day be is a question which the developments of the future alone can decide.

If the present rate of its growth shall continue unabated, sooner or later the time will come when it can increase no more. All the resources of the earth will be utilized and strained to the utmost to augment that life. But they cannot. Gradually the potential energies of nature which support life will be dissipated as energy of motion. And as those energies dwindle and disappear, the quantity of human life will fall away contemporaneously. The time must come when that quantity will be zero.

THE TITANOTHERIUM BEDS.

BY J. B. HATCHER.

In 1857 Meek and Hayden gave the name *Titanotherium* bed to the lowest member of the fresh water, Miocene, lake deposits of the White river, Bad Lands of Dakota and Nebraska.[1] They named these beds from the genus *Titanotherium*, established by Leidy in 1852.[2] This genus embraces the largest, most abundant, and most characteristic vertebrate fossils found in these beds. In 1870 Professor Marsh discovered, in northeastern Colorado, an exposure of these beds, farther south than they had then been reported.[3] He then referred them to "The true Titanotherium beds." In 1877 Professor Marsh proposed the name Brontotherium beds for this same series of strata, from his proposed genus *Brontotherium*.[4] Since there can be no doubt that the *Titanotherium bed* M. and H., and the *Brontotherium beds* Marsh, are identical, and since the former has a priority of at least twenty years, it should be retained.[5] In this paper the plural will be used, as expressing more nearly the true nature of the deposits.

GEOGRAPHICAL DISTRIBUTION OF THE TITANOTHERIUM BEDS.

The Titanotherium beds are known to have a surface exposure in various portions of the western interior plains region. That exposure from which they were first named and described and from which Hayden first made and published a section of them in 1863,[6] is of far greater extent than any other. The Titanotherium beds of this exposure are known to occupy a considerable portion of that country embraced between the Cheyenne, Missouri, and White rivers in S. Dakota, with a western continuation, extending along the eastern and southern slopes of the Black Hills, and westward to near the town of Douglas in Wyoming. While this exposure is seen to have a considerable extent from east to west, yet from north to south it is of very limited extent. This is due to a very slight dip of these beds to the southeast, where they soon pass under the overlying Oreodon and Loup Fork beds. That range of bluffs in southwestern S. Dakota, northwestern Nebraska and central Wyoming, known as Pine Ridge, may be considered as the southern limit of this exposure of the Titanotherium beds. The beds of this region occupy a considerable portion of southwestern S. Dakota, extreme northwestern Nebraska, and a very narrow strip in central and eastern Wyoming. Besides this exposure of the beds, there are other isolated exposures at Long Pine, Nebraska; in northeastern Colorado; in Wyoming, along the Rattlesnake Range, north of the Sweetwater; and Professor Cope has described remains of Titanotheriidæ from Canada.[7]

---

[1] Proc. Phila. Acad. Nat. Sci., 1857, p. 120.

[2] Ancient Fauna of Nebr., Leidy, 1852, p. 72.

[3] Am. Jour. Sci., Sept., 1870, p. 292.

[4] Am. Jour. Sci., 3d series, Vol. xiv, p. 354.

[5] Titanotherium, Leidy, 1852, is antedated by Menodus Pomel, 1849; but Menodus is essentially preoccupied by Menodon von Meyer, 1838.

[6] Proc. Am. Phil. Soc., 1863, Vol. xii, p. 31.

Although the surface exposures of the Titanotherium beds are of comparatively small extent, yet from the distribution of these exposures the beds are known to extend over a considerable portion of S. Dakota, Nebraska, Colorado, Wyoming, and perhaps portions of Montana and N. Dakota.

DESCRIPTION OF THE DEPOSITS.

The Titanotherium beds may be briefly characterized as a series of usually light colored, sometimes variegated clays, alternating with less extensive deposits of sandstones and conglomerates, situated at the base of the Miocene and containing among other fossils the remains of Titanotherium and allied forms.

The typical locality from which Meek and Hayden first named the Titanotherium beds and from which the latter first made and published a section of them, is also that locality in the Bad Lands of S. Dakota, which has been more thoroughly explored for vertebrate fossils than any other locality in these beds. It is located in that portion of Washington county embraced between the White and Cheyenne rivers, at that point where they approach nearest to each other. This particular region has not only proved especially rich in vertebrate fossils, but the Titanotherium beds and the entire Miocene series, up to the Loup Fork, has attained a development here unsurpassed, if not unequaled, elsewhere. In no other region has erosion done more to aid the investigator than here; whether his aim be to study the country from a purely geological standpoint, to collect material for the paleontological laboratory, or to study the laws and observe the rate and effects of erosion, under the many and varied circumstances which this region presents. Since the materials composing the Titanotherium beds are very similar throughout the entire distribution of the beds, a description of the deposits at the typical locality may be considered as representing fairly well the character of the deposits at any other locality.

---

[7] Contributions to Can. Pal., Vol. iii, p. 8.

The section published by Hayden in 1863 agrees in all important points with those published since by other authorities. As stated by Hayden, the beds vary in thickness at different localities. At no locality has he given a thickness of more than 100 feet. The writer has found, by actual measurement, that they attain a thickness in some places at least, of 180 feet. As stated before, they are composed of clays, sandstones, and conglomerates. The clays greatly predominate, consist of very fine particles, and are quite compact. In places they are composed almost entirely of pure kaolin, but they often contain a considerable portion of sand. Near the bottom of the beds the color is often red or variegated, due to the presence in them of small quantities of red oxide of iron; but the prevailing color is a very characteristic and delicate greenish white. The clays usually contain little or no cementing substance, and are held together almost entirely by adhesion. Occasionally, however, there are quite persistent layers of clay nodules, or concretions in which the clays are firmly cemented by carbonate of lime. Owing to the extreme minuteness of the particles forming the clays and the absence of sufficient cementing material in them, in most places they readily yield to the action of water and are quite rapidly eroded. The clays of the Titanotherium beds were probably derived from two sources, viz., from the Cretaceous clays and shales, and from the kaolinization of granitic feldspars.

The sandstones are never entirely continuous, and never more than a few feet thick. They present every degree of compactness, from loose beds of sand to the most solid sandstones. They are composed of quartz, feldspar and mica, and are evidently of granitic origin. When solidified the cementing substance is carbonate of lime.

The conglomerates, like the sandstones, are not constant, are of very limited vertical extent, never more than a few feet thick. They are usually quite hard, being firmly held together by carbonate of lime. A section of the beds taken at any point and showing the relative position and thickness of the sandstones, clays, and conglomerates is of little value, since these vary much at different and quite adjacent localities.

The varying hardness of the different strata of the Titanotherium and overlying later Miocene beds, by offering unlike degrees of resistance to erosion, have succeeded in producing in this particular region an exhibition of characteristic Bad Lands scenery, unsurpassed elsewhere in the Miocene. The surface of the country in this region is scarred by numerous deeply eroded canyons. The intervening ridges are rugged and barren, often terminating for miles in sharp, serrated crests. The walls of these canyons present a series of terraces or projecting ledges from top to bottom, due to different degrees of hardness in the different strata. Sometimes these ledges are but a few feet wide, or just wide enough to allow a person on foot to pass along on them. At other times when the harder layers of which they are composed are of greater thickness, they may be several hundred feet wide, and their surface strewn with the fossil bones of Titanotherium, Elotherium, Hyracodon, Hyænodon, Oreodon, turtles, etc., washed out of the overlying beds, by the slow process of denudation, presents a remarkable, not to say, sepulchral appearance.

Toward the interior of the Bad Lands, midway between the White and Cheyenne rivers, side branches of the main canyons have cut their way entirely through the dividing ridges and have produced particularly picturesque effects. Characteristic among these are the Devil's Tower, at the south end of Sheep Mountain, in the eastern portion of the Bad Lands; Chimney Rock, near their center, and the Tabled Rocks along their western border.

The location of such especially characteristic Bad Land scenery, in this particular region, is doubtless due to the near approach of the White and Cheyenne rivers to each other at this place. Since the Miocene deposits of this region are essentially horizontal, and form the summit of the divide between these two streams; this divide would be of essentially the same altitude, in reference to the beds of these streams, whether the latter were *near together* or *far removed* from each other. Therefore these streams upon approaching nearer to each other, as they do in this region, where they are only about 20 miles apart, would greatly reduce the length of their respective, intervening tributaries, without decreasing the height of the divide which separates them. This would necessarily increase the average rate of fall of the tributaries, and correspondingly the rapidity of the flow of their waters, and therefore the erosive power of the latter.

In various portions of the Titanotherium beds there are numerous vertical veins of chalcedony running through the beds in every direction. These veins vary in thickness from that of a sheet of paper to about two inches. On first thought the writer was inclined to attribute their origin to mud cracks, any particular region where they now occur having been for short periods, during seasons of low water, above the water level and subjected to the action of the atmosphere and the heat of the sun became baked and cracked; just as we now so often see at low water along the mud flats of our streams and lakes. But it is obvious that if these veins owe their origin to mud cracks they would be filled, not with chalcedony, but with the same materials as the overlying beds; for when the waters again covered this region, the mud cracks would be immediately filled by sedimentation and with the same materials that now compose the overlying beds. It has since occurred to the writer, that these cracks were not made while the particular strata in which they now appear occupied the immediate bottom of the lake, but after the overlying beds were deposited. The extreme fineness of the particles forming the clays of the Titanotherium beds in those places where these veins occur is evidence that the clays were deposited by a slow process of sedimentation in still waters. The bottom of a lake where such materials were being laid down would consist for several feet of a very thin mud or ooze. This would gradually become firmer toward the bottom as deposition continued, but would still mechanically retain a considerable per cent. of water. Later, when the entire overlying series of strata were deposited and the region brought permanently above the water level this imprisoned water would gradually disappear, by filtration or otherwise, aided perhaps by the pressure of the superincumbent beds. This loss of moisture in the clays would diminish their volume and bring about a readjustment of the particles composing them. The decrease in volume would be taken up in two ways: First, as in the case of mud cracks, the particles would tend to collect about certain centers in the beds, and these centers of adhesion would increase laterally by the attraction of adjacent particles until cracks of varying thickness would form between the peripherys of adjacent centers of adhesion. The pressure of the overlying beds would determine the vertical direction of these cracks, and would also afford the means for the second way, by which the decrease in the volume of the clays would be taken up, viz., by a decrease in the vertical thickness of the beds. These cracks, thus formed far beneath the surface, were afterward filled by chalcedony dissolved out of the overlying beds by heated waters percolating through them. Occasionally other minerals, as ordinary calcite and its less common variety known as Iceland spar, are found in small cavities in these veins. Localities containing these peculiar veins of chalcedony resemble both in appearance and structure a huge septaria, except that the veins in the former are much smaller in comparison with the area of the intervening spaces than in septariæ. A singular fact in connection with the position of areas exhibiting this peculiar structure is also thought to afford in itself evidence in favor of this view of the origin of the veins. These veins occur only in certain localities of limited area. Any single locality is never more than a few square miles in extent. These small and isolated areas, wherever it has been possible to determine their relation to the underlying beds, have been found to have been deposited in an eroded valley or depression of the latter. Such depressions would afford a natural basin for the waters, held mechanically by the clays, and would prevent a rapid drainage during their deposition.

STRATIGRAPHICAL POSITION OF THE TITANOTHERIUM BEDS.

THE UNDERLYING BEDS.

The Titanotherium beds are underlaid by various older formations, from the Laramie to early Paleozoic or perhaps Archean. In most places they rest unconformably upon the eroded surface of some member of the Cretaceous, most frequently the Fort Pierre shales. At the mouth of Beaver creek, a tributary of White river, near the Nebraska and Dakota State line, the writer in 1886 observed the Titanotherium beds resting upon the eroded surface of the chalk of Cretaceous No. 3, so well developed in central and western Kansas. This is believed to be a more northwestern extension of these beds than had then been reported.

THE TITANOTHERIUM BEDS.

The Titanotherium beds may be divided into Lower, Middle, and Upper beds, each characterized by different forms of the Titanotheriidæ. Accepting a total thickness of 180 feet as the maximum thickness of these beds, 50 feet of this would belong to the Lower, 100 feet to the Middle, and 30 feet to the Upper beds. The different forms of Titanotheriidæ, especially characteristic of these three divisions will be pointed out and figured later in this article.

The Overlying Beds.

The Titanotherium beds are everywhere overlaid by the Oreodon beds, except where the latter have been removed by erosion. So far as noticed there are in the Bad Lands of S. Dakota no evidence of any unconformity between the Oreodon and Titanotherium beds, unless the sudden change from one fauna to another should be regarded as evidence of an unconformity or at least as indicating a considerable break in sedimentation between the two beds.

Southwest of the Dakota Bad Lands in the extreme northwestern portion of Nebraska there seems to be some evidence of an unconformity between the Titanotherium and Oreodon beds, or at least that for a considerable period immediately following the deposition of the Titanotherium beds, this region became dry land and that the Oreodon beds were subsequently laid down upon the eroded surface of the Titanotherium beds. At the extreme head of Cottonwood creek, a small tributary of White river, from the northwest, in the northwestern part of Dawes county, there is an isolated butte composed entirely of the Titanotherium beds and containing many Titanotherium bones. The different strata composing this butte are horizontal. About one mile south of this isolated butte is a range of bluffs of the characteristic Oreodon beds, containing numerous bones of Oreodon and other associated animals.

In the first mentioned butte Titanotherium bones are found at the same altitude at which Oreodon bones occur in the bluffs to the south. Whether this occurrence of Titanotherium and Oreodon bones at the same altitude in quite adjacent beds is due to the Oreodon beds having been deposited upon the eroded surface of the Titanotherium beds, or to differences in the level of the bottom of the lake, at the beginning of the Miocene period, could not be determined. The horizontal position of the strata composing the Titanotherium butte would seem to favor the first conclusion, since if these strata had been laid down upon a sloping bottom they would, in their lower members at least, partake of the inclination of the bottom of the lake.

About six miles northeast of the town of Chadron, in Dawes county, Nebraska, on a small branch of the west fork of Dry creek, the writer, in 1886, while collecting missing portions of the skeleton of Professor Marsh's type of *Titanotherium* (*Brontops*) *robustum*, discovered by H. C. Clifford in 1875, observed several feet above the horizon in which this remarkably complete skeleton was found, and certainly not far from the top of the Titanotherium beds, positive evidence of a break in sedimentation at this place at least. This evidence consists in the occurrence at this place of a very dark colored layer of vegetable mould about two feet thick, accumulated no doubt during a period of elevation above water level.

Owing to the fact that the Titanotherium and Oreodon beds of S. Dakota and Nebraska are approximately horizontal, it is almost impossible to determine there, just what their stratigraphic relations are. Farther west, near the head of Lance and Harney creeks, in Wyoming, the Titanotherium beds, at least, dip to the southward at a considerable angle. The writer has been unable to make any but the most superficial observations in this region, which, if carefully examined, would doubtless furnish a solution of the actual stratigraphic relations of these beds.

Professor W. P. Jenney, of the U. S. Geol. Survey, has reported to the writer an account of the discovery of a small Miocene lake in the Black Hills. As a description of this singular and interesting deposit a portion of Professor Jenney's letter is quoted. He says: "About 1879–'80 I was informed that fossil bones . . . . had been found in a prospecting shaft near Lead City. I visited the locality and obtained possession of three nearly perfect skulls . . . . These fossils I sent to Professor Marsh at New Haven, accompanied by a letter giving a sketch and full description of the occurrence, and received a reply stating that they were all *Oreodon culbertsonii* (this specific name is from memory but I think correct).

"This Miocene deposit is situated about half a mile southeasterly from Lead City, South Dakota, and nearly five miles south of the city of Deadwood, at an elevation of about 5,200 feet above the ocean. . . . . Of the extent of this tertiary deposit very little is known. It does not outcrop at the surface and appears to occupy a small, deep channel or basin eroded in the Archæan slates which outcrop on all sides within a radius of 1000 to 3000 feet. . . . . This occurrence is peculiar not only in forming an outlier to the great Miocene deposits and in occupying a basin eroded in a range of steep Archæan hills where lakes are now unknown, but also in the nature of the deposit itself, which so closely resembles, in appearance at least, the deposits of the same age on the plains. The clays of the latter were probably derived from Cretaceous shales, but the sediments filling this lake would naturally be expected to be very different, the rocks in the vicinity being Archæan slates capped by Potsdam sandstone and shales, and locally overlaid by masses of eruptive post-Cretaceous porphyry. . . . ."

That this small lake was, during Miocene times, entirely isolated from the great body of water to the eastward can hardly be questioned. The similarity just referred to by Professor Jenney as existing between the deposits of the small lake and those of the larger one is probably due to the materials composing both having been derived largely from a common source. The prevalence everywhere throughout the Miocene of large quantities of sands and conglomerates, composed of coarse grains or pebbles of quartz, feldspars, and mica, is sufficient evidence that the materials composing the beds of the Miocene were derived largely from sources other than the Cretaceous shales, which contain little sand and are always very fine grained. The coarser sands and conglomerates were doubtless derived from Jurassic, Paleozoic, and Archean rocks, and a considerable portion of the Miocene clays probably owe their origin to the decomposition of the slates of these older formations and the kaolinization of granitic feldspars.

DIVISION OF THE TITANOTHERIUM BEDS INTO LOWER, MIDDLE AND UPPER BEDS.

During the seasons of 1886, 1887, and 1888, the writer spent fifteen months in the White River Miocene beds of S. Dakota and Nebraska, collecting material for Professor Marsh's Monograph on the *Titanotheridæ* (*Brontotheriidæ*). Among the material collected was 105 nearly complete Titanotherium skulls, and many portions of skeletons and disarticulated bones; besides the remains of many other associated animals.

Early in the season of 1886 it became apparent that certain forms of skulls were characteristic of certain horizons in the beds. This fact showed the importance of keeping, so far as possible, an exact record of the horizon from which each skull or skeleton was taken. From actual measurement the vertical range of the Titanotheriidæ was found to be about 180 feet. For convenience in keeping a record of horizons the beds were divided into three divisions of 60 feet each, and each of these three divisions was subdivided into three divisions of 20 feet each. The different skulls and skeletons, when dug out, were each given a separate letter or number, and this letter or number was placed in that subdivision of the beds from which the skull or skeleton was taken.

At present about 60 of these skulls and several more or less complete skeletons have been freed from their matrix. When studied in connection with the horizons from which they were taken, these remains show that a regular and systematic development took place in these animals from the base to the top of the beds. The most noticeable change which took place in the Titanotheriidæ was a gradual and decided increase in their size from the lowest to the uppermost beds, as is shown by the increase in the size of the skulls, fore and hind limbs, and other portions of the skeleton. Individuals found near the bottom of the beds are little, if any, larger than the living rhinoceros. From this they gradually increase in size as we go up until at the top we find a type described by Professor Marsh as Titanops, rivaling the modern elephant in size.

This increase in size from the base to the summit of the beds was attended by a very marked development in certain portions of the skeleton, noticeable among which are the following: A variation in shape and an increase in the size and length of the horncores as compared with the size of the skulls, attended, near the summit of the beds at least, by a decided shortening of the nasals.

There were also changes taking place in the dentition of these animals, especially in the number of incisors and in the structure of the last, upper, true molar. The number of incisors, though probably never constant, even in the same species, shows a tendency to decrease in skulls found near the summit of the beds. At the base of the beds the number of incisors is from one to three on a side, while at the top there are never more than two on a side, often only one, sometimes none. In skulls from the very lowest beds the incisors have already become so rudimentary as to be no longer functional. As would be expected, the number of incisors decreased after they became of no functional value. In the matter of incisors the Titanotheriidæ were, at the time of their extermination, in a fair way to accomplish just what the somewhat related but more persistent Rhinocerotidæ have very nearly succeeded in doing, viz., the elimination of the incisor dentition. The number of incisors in the Titanotheriidæ varies with age in the same individual. These teeth were but loosely set in the comparatively thin alveolar border between the canines, and showed a decided tendency to drop out in old age, their alveoles afterward becoming entirely closed. This is well shown in several instances where on one side of a jaw there may be 1, 2, or 3 incisors, while on the other side of the same jaw there will be 0, 1, or 2 and no alveole for the missing tooth. The number of incisors can hardly be considered as of either generic or specific importance in the Titanotheridæ where they are no longer functional and vary with individuals in the same species and with age in the same individual. The same may be said of the presence or absence of the first premolar.

In the structure of the last upper true molar we find a change taking place in the development of a posterior, inner cone. Individuals from the base of the beds show scarcely any indications of this cone, but as we proceed upward in the beds, there is a marked increase in the development of the inner basal ridge on the inner posterior angle of the last upper true molar. This development frequently succeeds near the middle of the beds in producing a perfect posterior inner cone.

Other variations are noticeable in the dentition and in the character of the nasals, but they are common to individuals from any horizon whatsoever, and are thought to be of sexual importance only. Among variations of this nature may be mentioned the following: Differences in the size of the canines as compared with the molars and premolars; presence, absence, or want of continuity of an inner basal ridge on the superior premolars; comparative strength and rugosity of the nasals. Since slender and delicate nasals, small canines and upper premolars with only a very slight or no basal ridge on the inner border, are associated in the same skulls; these skulls are considered to have belonged to females, while those skulls in the same horizons, with stronger and more rugose nasals, larger canines and a well developed inner basal ridge on the upper premolars represent their male companions.

There were also changes taking place in other portions of the skeletons of these animals, important among which may be mentioned the development of a third trochanter. Femora from the bottom of the beds were quite small and with only a rudimentary third trochanter. Toward the middle of the beds they increase in size and show a well marked third trochanter, while at the top of the beds this process has become quite well developed and is of moderate size.

The most important change that took place in the Titanotheriidæ, and the only one perhaps of generic importance, is to be found in the fore foot. Early in the season of 1886 the writer discovered near the base of the Titanotherium beds a portion of the skeleton of a very small individual with both fore feet and limbs in position. The carpus of this individual was found to possess an additional bone (*the trapezium*) hitherto unknown in the Titanotheriidæ. This fortunate discovery of a skeleton, at the base of the deposits, with a distinct trapezium showing a perfect articulation with the trapezoid, may be found to be of considerable importance as establishing a closer relation of Titanotherium to Diplacodon from the upper Eocene than has yet been pointed out, especially if this latter form should prove to possess a trapezium, as it is now almost certain it did. The trapezium, though present in the earliest forms of the Titanotheridæ, was quite small and soon disappeared entirely, leaving no vestige of a first digit. Among many more or less complete fore feet found in the upper part of the Lower, in the Middle, and Upper beds, no trapezium has yet been found, while several have been found at the base of the beds.

It is quite probable that those forms of Titanotheriidæ with three incisors described by Professor Marsh under the generic name of *Teleodus* will be found to possess a trapezium.[8] If such should prove to be the case, the genus *Teleodus*, Marsh can then be considered as distinguished from that of *Titanotherium*, Leidy by a definite and constant character, viz., the presence of a trapezium. Individuals with three incisors collected by the writer have invariably been found at the bottom of the beds and the small size of other individuals with three incisors, discovered by other collectors, indicate that they also were taken from the same horizon. There would appear, therefore, to be little doubt that the presence of a trapezium and three incisors are associated in the same individuals. That the latter character was not constant is shown by the presence of three incisors on one side and two on the other in the same jaw, with no alveole for the missing tooth.

Variations occur also in the number of sacral vertebræ. But since these are clearly dependent upon the age of the individual they are not considered here. All fully adult specimens show four sacrals, younger ones only two or three.

In figure 3 the side view of a skull from the base of the Titanotherium beds is represented, showing the small round horncores and long nasals which are characteristic of skulls from this horizon. In figure 2 the side view of a skull from the Middle beds is represented, showing horncores and nasals of medium length. Figure 1 represents the side view of a

---

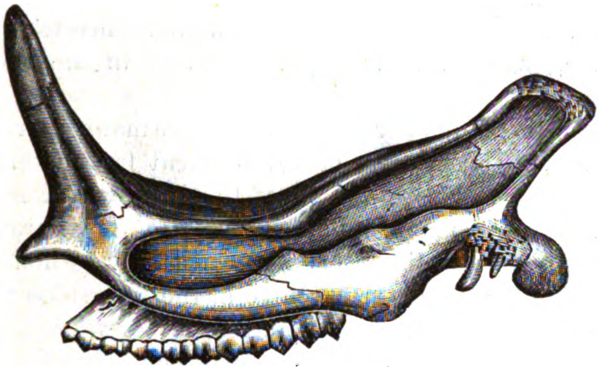
[8] Am. Jour. Sci , June, 1890, p. 524.

Oreodon Beds.		Reddish brown clays, with occasional concretionary layers, Remains of Oreodon, Hyracodon, Hyænodon, Elotherium, etc. About 500 feet thick.
TITANOTHERIUM BEDS, 180 FEET THICK.	Upper Beds, 30 ft.	Characterized by Titanotheriidæ of large size. Horns 10–18 in. long, elliptical to sub-ovate in cross-section. Nasals very short and pointed. Incisors never more than 2. Internal cingulum on upper premolars not strongly marked in either sex. Posterior inner cone on last upper molar. Third trochanter present. Trapezium absent. General form of skull shown in fig. 1.
	Middle Beds, 100 ft.	Characterized by Titanotheriidæ of medium size. Horns 4–10 in. long, circular to sub-triangular in cross-section. Nasals of moderate length, with broad or pointed extremities. Incisors never more than 2. *Strong* internal cingulum on upper premolars of males only. Posterior inner cone on last upper molar. Third trochanter present. Trapezium absent. General form of skull represented in fig. 2.
	Lower Beds, 50 ft.	Characterized by Titanotheriidæ of small size. Horns rudimentary or from 1–4 in. long, circular in cross-section. Nasals long and pointed. Incisors occasionally as many as 3. *Strong* internal cingulum on upper premolars in males only. No posterior inner cone on last upper molar. Third trochanter somewhat rudimentary. Trapezium present in earliest forms. General form of skull shown in fig. 3.
Underlying Beds.		Represented by various formations from Laramie to Archean.

Section of Titanotherium Beds showing relative thickness of Upper, Middle, and Lower Beds, with brief descriptions of forms of Titanotheriidæ common to each.

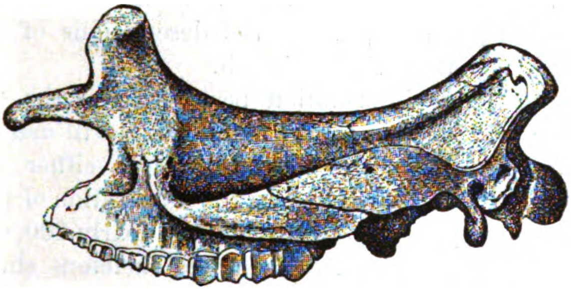
skull from the Upper beds with the characteristic long horn-cores and short nasals. The nasals are not so short in this skull as in many others. The figures are drawn to the same scale, one-twelfth natural size, and represent well the increase

FIG. 1.



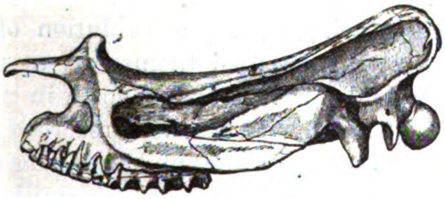
Titanotherium acre, $\frac{1}{12}$ Cope.

FIG. 2.



Titanotherium ingens Marsh; $\frac{1}{12}$ (After Marsh).

FIG. 3.



Titanotherium heloceras Cope; $\frac{1}{12}$ (After Marsh).

in the size of the skulls from the base to the summit of the beds. They are arranged on the opposite page in the order in which they occur in the beds commencing at the top.

Intermediate forms in the middle of the beds have a much greater vertical range than their smaller ancestors in the underlying beds or their larger survivors in the overlying beds.

Between the skulls here figured there are many intermediate forms, showing every stage of development from a very small skull found at the very bottom of the beds, which measures only 22 inches from occipital condyles to the extremity of nasals, with very rudimentary horncores only 1⅛ inches high to forms similar to that represented at the top, which measure more than 36 inches from occipital condyles to extremity of nasals, with horncores over a foot long and having an expanse of two feet or more.[9]

In the section of the Titanotherium beds accompanying this paper the relative thickness of the Lower, Middle, and Upper beds are shown, with brief descriptions of forms of Titanotheridæ characteristic of each.

Much additional information bearing upon the development which took place in the Titanotheriidæ will doubtless be brought to light, when the large collections either made or purchased by the writer for use in the preparation of Professor Marsh's monograph and now numbering nearly 200 complete skulls and many more or less complete skeletons shall have been worked up. It is safe to say that there is scarcely a single foot of sediment within the entire vertical range of the Titanotheridæ that is not represented by material in this collection. Only those facts bearing upon the evolution of the Titanotheriidæ which have presented themselves to the writer in connection with his field work are set forth in this paper. It is to be hoped that the few results here recorded may suggest to other collectors the importance of keeping, as nearly as possible, accurate data of horizons; since a familiarity with the different horizons as characterized by different and closely related forms is clearly indispensible in making an intelligent classification of any group of fossils, more especially when they are as highly specialized and as susceptible to the influence of constantly changing environments as were the Titanotheriidæ.

---

[9] These facts were communicated by the writer to Professor Marsh in 1886, and were referred to by the latter in the Am. Jour. Sci., Feb., 1889, p. 163, and the Ninth Ann. Report U. S. Geol. S., p. 114.

Yale Museum, Jan. 16, 1893.

AN ORGANISM PRODUCED SEXUALLY WITHOUT CHARACTERISTICS OF THE MOTHER.

By Th. Boveri.

[In offering a translation of Dr. Th. Boveri's paper, entitled Ein geschlechtlich erzeugter Organismus ohne mütterliche Eigenschaften, I have been guided by two motives. First, to make this paper, which will certainly become a classic in Biological literature, accessible to American students, since the journal in which it appeared "Sitz. d. Gesellschaft für Morphologie und Physiologie zur München" × Sitzung am 16 Juli, 1889, has a very limited circulation in this country.

In the second place, to point out the new avenues of research that such work opens. Results of this kind are of the utmost importance, inasmuch as they touch the very heart of the question of Heredity. Each advance in our knowledge gained by experimental work of this sort, carries forward rapidly our understanding of the most vital phenomena of life.

Results of this importance must be verified over and over again, until all chances of error (by no means small) are eliminated. Dr. Boveri writes that during the present Winter it is his hope to carry forward this work at Naples.

Three small wood cuts were given in the original paper. Dr. Boveri has most generously placed at my disposal the original drawings as well as five additional figures. These are added to the present account. The original figures gave side views of the Echinus larva, the Sphærechinus larva, and the side view of the bastard larva (Echinus ♂, Sphærechinus ♀). Three of the new figures give posterior views of the same larvæ and two of the *Dwarf Larvæ.*

Weismann, referring to Boveri's work, in his essay on Amphimixis affirms that *two spermatozoa enter the enucleated* egg to form the segmentation nucleus. I wish to call attention to the foot note in Boveri's paper, where it is positively stated that only *a single spermatozoon enters the enucleated egg.*

T. H. Morgan.]

Although the law, that the substances giving the definite and hereditary characters to the cell are entirely contained in the nucleus, is at times spoken of as a very probable hypothesis, but again even as a fact, yet it may be easily shown that this can be known to us neither in the well known phenomenon of fertilization of the egg, nor through the researches already carried out, concerning the rôle of the nucleus in the protozoa.

Simple reflection shows moreover that the determination whether or not this Theory of Inheritance (Vererbungs-Theorie) is true, can be settled in one way alone, viz., to take two different sorts of cells, utilizing the nucleus of one and the protoplasm of the other, to form a new cell. If the nucleus and protoplasm are so constituted that they can exist together, then will the properties arising from this cell, made artificially, answer our question. For then either the exclusive qualities of that cell will develop which had held the nucleus, or those will arise that come from the protoplasm, or lastly, from a mixture of both; showing whether the nucleus alone or the protoplasm alone (or both of the two constituents) is able to transfer to the other the properties it possesses on account of its origin, so as to bring about a reverse result in the other.

The idea of inheritance in the narrower sense corresponds to such a choice of the two cells, that the cell produced artificially out of the nucleus of the one and the protoplasm of another forms a cell capable of development.

Moreover in the case of the egg, as in no other, an opportunity is given to solve the question; because for no other cell do we possess so accurate a method of judging of its qualities as is given in the egg by means of the adult organism that comes from the egg.

Rauber[1] has already carried on a research of this sort. He describes it as follows. "The nucleus of the first segmentation sphere of a frog's egg was drawn out an hour after fertilization, by means of a pipette stuck into it. The same process was carried out in a fertilized toad's egg. These two pipettes were exchanged, and the nucleus of the toad's egg placed in the frog's egg, and the nucleus of the frog's egg into the toad's egg. Now if the nucleus alone carries the hereditary functions then there must develop out of the frog's egg a toad, and out of the toad's egg a frog." As was to be anticipated, the eggs did not develop further, and at first sight there seems to be no reason to expect that such an experiment should succeed. For if we were in a position to take out, without further injury, the nucleus from cells, still we could scarcely introduce by artificial means a new nucleus, without causing such fundamental alterations of the one or the other part, as to make further life impossible.

---

[1] Rauber Zoologischer Auzeiger 15 March, 1886, pp. 170.

But just here Nature herself offers the solution by means of which we can accomplish our purpose, because it makes the second and more difficult part of the experiment an entirely normal process—the entrance of the spermatozoon into the egg may be utilized.

The basis for my research is founded on the discovery of the Hertwig brothers.[2] When these investigators shook for a long time the eggs of the sea-urchin in a test tube, containing a small amount of water, in order to alter them mechanically, they found that in consequence of the shaking some of the eggs fell into pieces, and while some of the pieces contained nuclei, others did not. It was further shown that these enucleated (non-nucleated) fragments, as well as the nucleated ones could be fertilized, and that an active segmentative process took place in them. What followed in these cell masses was not determined by the Hertwigs. I have myself verified this discovery during my last visit to the Zoological station of Naples, and found *that the enucleated and fertilized fragments of eggs developed as far as and formed as complete larvæ as did the perfect nucleated* egg. From the enucleated fragments which I isolated I reared in a series of dishes larvæ[3] (about half of them developing normally) that formed *dwarf-larvæ.* These were in some cases only one-fourth as large as the normal larvæ, but otherwise agreed perfectly with these, and even lived for the same length of time, i. e., about seven days.

---

[2] O. and R. Hertwig. Ueber den Befruchtungs und Theilungs-Vorgang des Thierischen Eies unter dem Einfluss ausserer Agentien Jena 1887.

[3] In a more extended account of my experiments I will describe in detail the methods which must be used in order to be certain that we are dealing with pieces without nuclei, and on the other hand the best method to give the more delicate pieces favorable conditions of development. Here I may remark that in order to obtain positive results, a sufficient size of the fragment is necessary, also that they have a nearly spherical form and sufficient amount of water for their development, and that MONOSPHERIC FERTILIZATION TAKES PLACE.

This result is in itself certainly full of interest. It shows that the sperm-nucleus itself possesses all of the properties necessary to function as the first segmentation nucleus, and the result, which shows the prevailing opinion concerning the nature of fertilization to be erroneous, gives an important support to my view, published in several places, concerning the interpretation of the process. I desist from considering the point further here, in order to turn to the interpretation of the experiments dealing with the questions raised concerning inheritance.

With the possibility of fertilizing enucleated egg-pieces and of bringing these to a normal development, we have fulfilled all of the conditions in order to reach the end which Rauber failed to attain. We have an enucleated egg—for the fragment has the value of an entire egg, and we are able by means of a process of fertilization to introduce another nucleus into the egg, the egg still possessing the power to develop. And now instead of using a spermatozoon of the same species, we introduce the spermatozoon of another in order to produce the hypothetical case of "the toad's egg and the frog's nucleus."

It is even possible to bastardise the egg fragments (obtained by shaking) of one species of sea-urchin with the sperm of another species, and to rear them far enough to determine whether the developing organism shows the qualities of both species or only of the one species. For such an experiment the sea-urchin presents favorable conditions. It is possible, although the results are somewhat variable, to cross-fertilize two species standing quite far apart. And in the second place the larva of the sea-urchin shows in a very few days, principally through the development of the calcareous skeleton, a very well defined shape. This is constant for each species and so well defined for each species, that at the age of four days we can distinguish the two species of larvæ just as easily and surely as in the adult condition.

The two species that I have used in my research are *Echinus microtuberculatus* and *Sphærechinus granularis.* I am certain that a more favorable combination than this can be found, for although the two species are well adapted inasmuch as their larvæ differ very considerably from one another, yet there is to be taken into account, the fact that cross-fertilization between the two is so difficult that in my experiment out of 1000 picked eggs (Sphærechinus ♀, Echinus ♂) not a single fertilized egg resulted. Of the four species found at Naples in great abund-

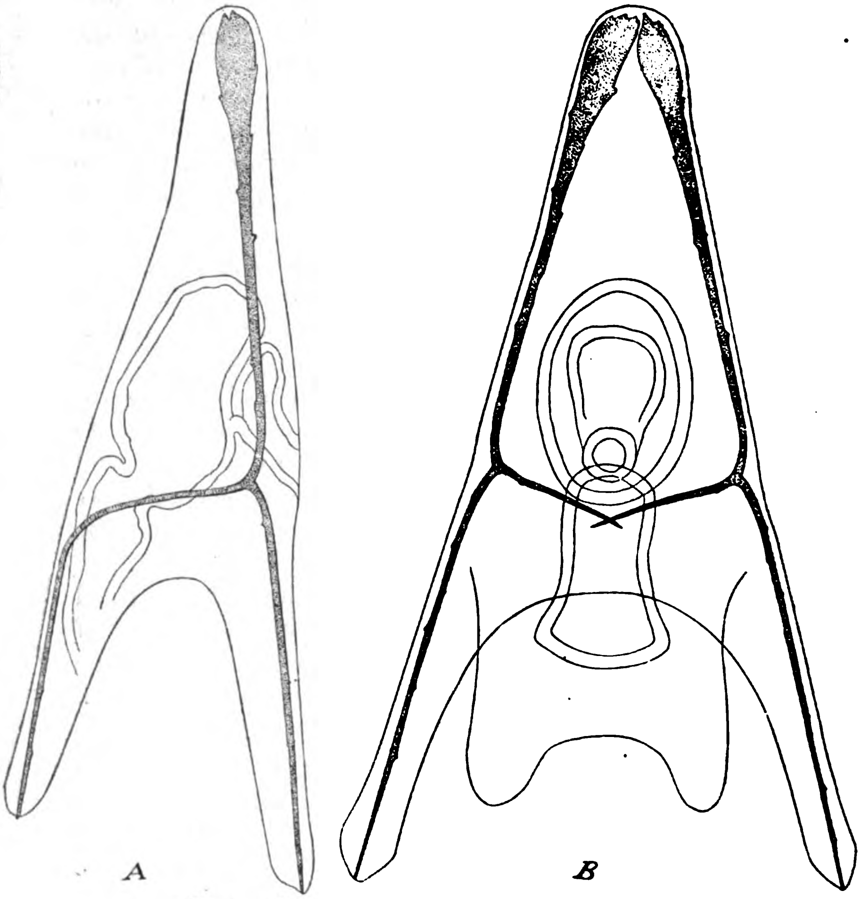


Fig. 1. *Echinus microtuberculatus* larva; pure type.

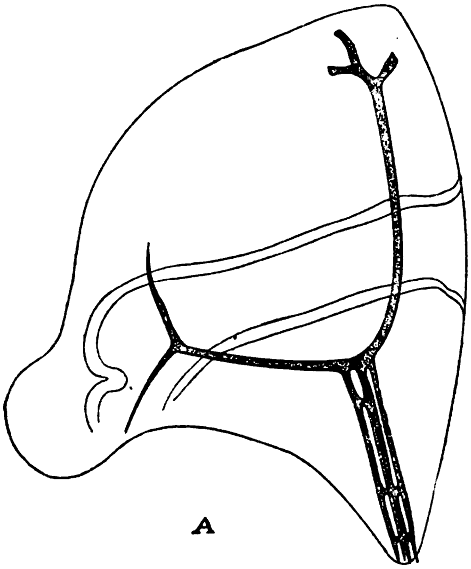


Fig. 2. *Sphærechinus granulatus* larva; pure type.

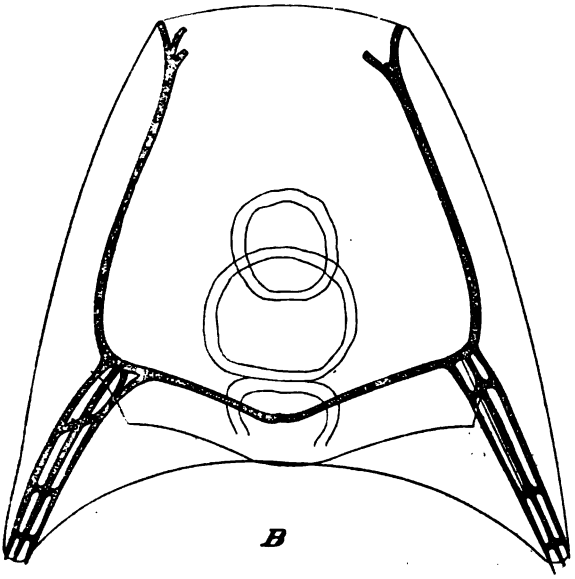


Fig. 2. *Sphærechinus granulatus* larva; pure type.

ance, these two alone are useful, and lend themselves to the solution of our problem.

Since the differences throughout are dependent on the distinctive peculiarities of the larvæ used, it is necesssry first to make clear the difference in structure of the larval forms that we are considering. The two accompanying figures will render a long account needless.

Fig. 1, A and B, represents an Echinus larva, and fig. 2, A and B, that of Sphærechinus. The two figures oriented alike, show the circumference of the body and the calcareous skeleton seen in profile [and in front]. The differences in structure of the

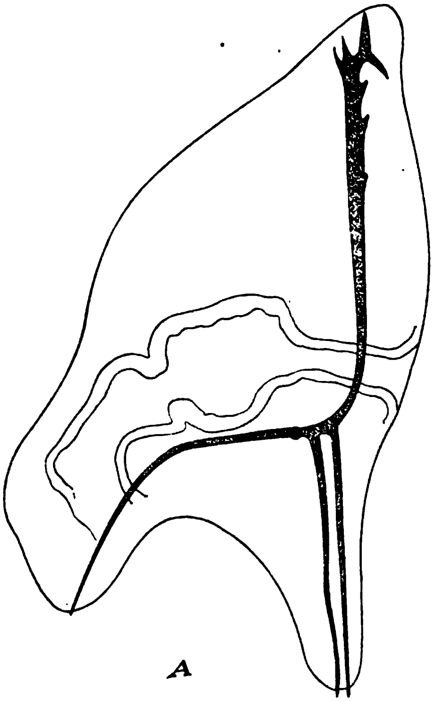


Fig. 8.
Larva of bastard of *Echinus microtuberculatus* ♂ and *Sphærechinus granularis* ♀.

body, particularly in the sheltered structures, are brought in these figures in the position best suited to the observer. The arrangement is sufficiently well shown in the figures to obviate any further description.[4] The enucleated egg-fragments of Sphærechinus were brought together with the sperm of Echinus.

[4] The generic name will suffice, from this on, in speaking of these two species.

If the nuclear substance alone is the bearer of the parental qualities, then larva of the pure Echinus type will be produced (Fig. 1). It is clear that in the experiment this conclusion can only be proved, if the bastards produced from fertilized eggs (we will call these the genuine Bastard larvæ) give a middle-form standing between the larvæ of the two parental species. For it is conceivable that the particular structures of the two species might not be able to commingle, so that the larvæ would, according to their surroundings, develop either the paternal or maternal qualities alone (the qualities of the other parent in each case remaining latent). In this case there would be no true bastard.

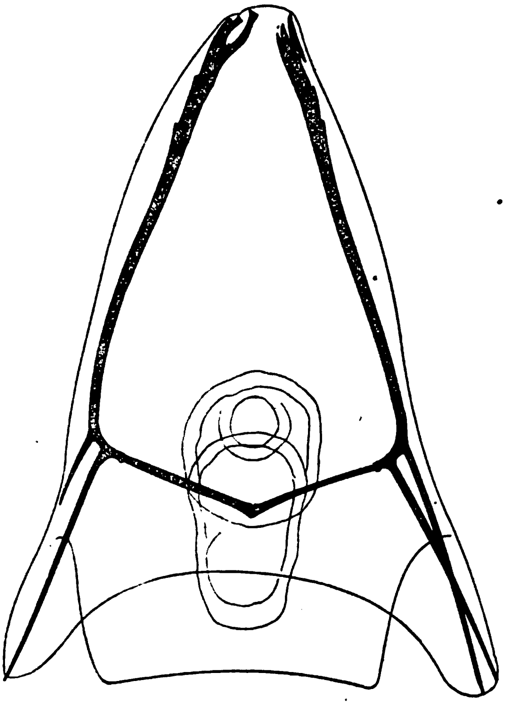


Fig. 3.

Larva of bastard of *Echinus microtuberculatus* ♂ and *Sphærechinus granularis* ♀.

I have reared such larvæ in great numbers and from many different individuals, and have in all certainly seen more than a thousand of them. The result was always the same. All genuine bastards, with not a single exception, represent both in the shape of the body as well as in the skeleton an almost exact middle form standing between the two parents. This is a new well defined form, and is always as such to be recognized and cannot be confused with either of the two parent larval forms. Fig. 3, A and B, which shows such a genuine Bastard larva, illustrates, as compared with figs. 1 and 2, this law better than many words could possibly do.

The result is otherwise if we shake into pieces the Sphærechinus egg before the entrance of the Echinus-spermatozoon. Certain of the eggs remain intact after the process, and these do give the genuine bastard form (Fig. 3). These are those formed from nucleated pieces, but another portion of the crossed larvæ agree entirely with the simple larva derived from the egg and spermatozoon of *Echinus microtuberculatus* (Fig.1). These must have been produced chiefly from enucleated fragments. (Fig. 4 A and B.)

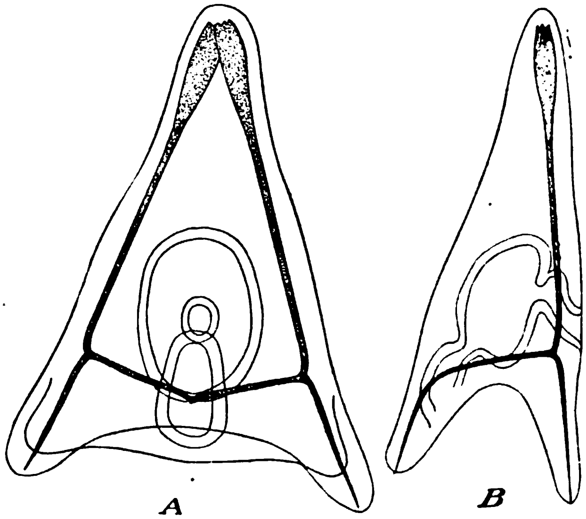


Fig. 4. Dwarf bastard larva of *Echinus* ♂ and *Sphærechinus* ♀ (fragment) of pure *Echinus* type.

That this is the correct interpretation is more clearly demonstrated by rearing in isolation the enucleated pieces. My results in this direction are on the whole not successful, and the explanation for this is to be found in the circumstance cited above, i. e., that the cross-fertilization between *Echinus microtuberculatus* ♂ and *Sphærechinus granularis* ♀ were scarcely ever successful out of 1000 cases. This small percentage of the whole number fertilized, where many millions of eggs or egg-fragments may be used, lends great improbability to the chance of getting successful results by isolating a few chosen examples of eggs. It is such a long and tiresome procedure to pick out and isolate the enucleated fragments from the shaken mass that in the limited time of my stay at the sea-shore I did not have the good fortune to see them develop in a single example.

I hold as sufficiently strong proof, in absence of direct knowledge, the result of those experiments in bastardization where enucleated were mingled with nucleated fragments, and with entire eggs. For after I have been able to reach the conclusion on the one hand by observing eggs and spermatozoa of the same species that enucleated pieces still develop, and on the other hand after it has been shown that the fertilization of nucleated eggs of Sphærechinus with Echinus sperm larvæ occasionally arise standing between the parent forms, there remains no other interpretation as to the origin of the dwarf-larva of pure Echinus except out of the enucleated fragments found there. But there remains a more definite result pointing to the correctness of such a conclusion. One can distinguish in a preserved and colored larva whether or not it has originated from a nucleated or enucleated egg, and this from the size of its nuclei. If the fertilized enucleated egg-fragment was the first segmentation nucleus which is formed entirely from A SPERMATOZOON NUCLEUS, the nucleus is half as large as a normal first segmentation nucleus, and this difference in size is handed down to all of the descendants of the egg cell, even to the larval stage. If now we kill larvæ of the same age derived from Sphærechinus eggs and egg-fragments fertilized by Echinus sperm, we have mixed together with the Bastard-type the true Echinus type, and the latter (true Echinus type) shows proportionately considerably smaller nuclei than the preceding one.

All doubt is thus removed, and it may be regarded as conclusive that by bastard fertilization of whole eggs or protoplasmic pieces having nuclei, larvæ are formed that stand midway between the larval forms of the parent species; but the larvæ arising from the *enucleated* fragments of eggs have entirely the characteristics of the parent (*male*) species. Herewith is demonstrated the law that the nucleus alone is the bearer of hereditary qualities. With the removal of the maternal nucleus are removed at the same time the maternal hereditary tendencies of the egg. And the maternal protoplasm, although in this case furnishing a large share of the material for the development of the new organism, is without influence on the form of the organism.

The phenomenon of growth of the enucleated protoplasmic mass is entirely governed by the introduced spermatozoon, and indeed to conclude by analogy, by the nucleus of the sperm. Whether the spermatic nucleus penetrates the egg protoplasm of its own species or of another species, the same result appears, namely, the larva is that of the male species. I might say that the nucleus possesses an assimilating power toward the protoplasm, since it produces the same sort of organism from material that appears to be different, according to our standards of truth. That the egg-protoplasm is similar in the two cases in every respect pertaining to its chemical constitution, I cannot admit, and do not even hold to be probable. Still such differences may, if they were present, be very easily explained, as due to the previous action of that nucleus, to which the enucleated protoplasm was at one time united, and any difference would thus not be incompatible with the law that all changes of form of the protoplasm are dependent on the constitution of the nucleus.

ON THE CLASSIFICATION OF THE LONGIPENNES.

By R. W. Shufeldt.

Few groups of birds there are that have received a greater amount of attention at the hands of comparative morphologists than the one I here consider as the Longipennes.

Considered apart from related ones, the suborder is fairly well circumscribed, and structurally, very surely a most homogeneous collection of bird-forms. It is abundantly represented in the United States avifauna, and here, as in nearly all other parts of the world, consists chiefly of the Gulls and Terns, the Skuas and Jaegers, and the Black Skimmer of the family *Rhynchopidæ*. We have the Skuas represented by but one species, *Megalestris skua;* and there are three Jaegers of the genus *Stercorarius*. There are upward of thirty Gulls referred to the genera *Gavia*, *Rissa*, *Larus* (20 species), *Rhodostethia*, and *Xema*, and about seventeen Terns, which are referred to the four genera *Gelochelidon*, *Sterna* (13 species), *Hydrochelidon*, and *Anous*.

Among the earlier classifiers of the *Laridæ*, we find P. Bruch and C. L. Bonaparte, the former being the author of two celebrated papers[1], and the latter of another which appeared between the times of their publication[2]. The confusing and misleading statments made in these three memoirs were subsequently to a large extent, eradicated by the excellent labors of Coues which appeared a few years after them,—although Coues, as he himself admits, suffered from the reliance he placed in their observations.[3]

---

[1] Bruch, P., *Monographische Uebersicht* der *Gattung Larus Lin. J.* f. *O.*, i, 1853, pp. 96-108, pl. ii, iii.

Ibid. Revision der Gattung Larus Lin. J. f. O., iii, 1855, pp. 273-293, pll. IV, V.

[2] Bonaparte, C. L., Notes sur les Larides. Naumannia, IV, 1854, pp. 209-219. Of these two exploits Coues says in his *Ornithological Bibliography*, "It may be remarked, in fine, of this article [Bonaparte's], that it is worse than worthless, being pernicious. It is ostensibly a review of Bruch's paper of 1853 [*supra*]; this being itself a very incompetent performance, confusion is here worse confounded by Bonaparte's criticisms and "rectifications." It seems to have had, among other undesirable results, the effect of setting Bruch at the business anew, as appears by the latter's paper of 1855, [above cited]. The two authors together made as complete a muddle as can be found in ornithology; woe to the confiding student who trusts either of them—*Crede experto!* Bruch and Bonaparte are "Scylla and Charybdis of Gull literature." (p. 1001.)

But we are more interested in those works wherein the taxonomy of the *Longipennes* is based largely upon the structure of the various species, and this Dr. Coues gave us later in his "Birds of the Northwest," a very solid contribution to the subject.[4] Here a very thorough study was made of the Gulls, Terns, Skimmers and others. His final classification, however, appeared ten years later, or in 1884[5] and stood thus:

ORDER.	SUB-ORDER.	FAMILY.	SUB FAMILIES.
Longipennes.	Gaviæ.	Laridæ.	Lestridinæ. Larinæ. Sterninæ. Rhynchopinæ.

Other Laridists have also ably treated the group and we can here but refer the student to the works of Nitzsch, Huxley, Schlegel, Blasius, Saunders, and Sclater and Salvin, bringing us down to the year 1880. Of these Huxley's work is deserving of especial mention,[6] and he upon certain structural characters placed the Gulls and their allies in his group "*Cecomorphæ,*" remarking that "This group contains the *Laridæ* (*Longipennes* Nitzsch), the *Procellariidæ*, the *Colymbidæ*, and the *Alcidæ.*" (p. 458). As a knowledge of the morphology of a number of these families became extended, this classification has been very much modified and altered. For instance, Alfred Newton in the 9th edition of the *Encyclopædia Britannica* under the article GULL (v. XI, p. 274) says, "The Family Laridæ is composed of two chief groups, *Larinæ* and *Sterninæ*—the Gulls and Terns, though two other sub-families are frequently counted, the Skuas (*Stercorariinæ*), and that formed by the single genus *Rhynchops*, the Skimmers; but there seems no strong reason why the former should not be referred to the *Larinæ* and the latter to the *Sterninæ*." Without being especially a classificatory work, W. K. Parker has given us some valuable researches on the development of the skull of *Gavia ridibunda* that has materially furthered our knowledge of the structure of the Gulls.

---

[3] Coues, E., Revision of the Gulls (Larinæ) of North America; based upon specimens in the Museum of the Smithsonian Institution. *Proc. Acad. Nat. Sci.* Phila., XIV, 1862, pp. 291-312. Also a review of the Terns (Sterninæ) of North America. *Proc. Acad. Nat. Sci. Phila.* XIV, 1862, pp. 535-559.

[4] Coues, E., Monograph of the North American Laridæ, 1874, pp. 587-715.

[5] Coues, E., Key to North American Birds, 1884, p. 732.

[6] Huxley, Thomas H., On the Classification of Birds; and on the Taxonomic Value of the Modifications of certain of the Cranial Bones observable in that Class. P. Z. S. 1867, pp. 415-472.

In the Check List of the American Orinthologists' Union, (1886, p. 84) we find the *Longipennes* divided into the three families *Stercorariidæ*, (2) *Laridæ* and the (3) *Rhyncopidæ*,—the second group being again sub-divided into the two sub-families, (1) the *Larinæ* to contain the Gulls, and (2) the *Sterninæ* to contain the Terns.

Finally, I have examined the classifications of Stejneger, Cope, and more particularly the one proposed by Fürbringer, and that distinguished ornithologist presents us with the following arrangement[7]:—(p. 1566.)

O. Charadriornithes.	S. O. Charadrii-formes.	G. S. lat. Laro-Limicolæ.	G. s. str. Charadrii.	F. Charadriidæ. F. s. str. Glareolidæ. F. s. str. Dromadidæ
				F. Chionididæ.
				F. Laridæ.
				F. Alcidæ.
				F. Thinocoridæ.
		G. Parræ.		F. Parridæ.
		G. Otides.		F. Oedicnemidæ. F. Otididæ.

His order *Charadriornithes*, is also made to include the Im. S. O. Gruiformes and the Im. S. O. Ralliformes, but we are not especially concerned with them here. Among the most recent classification we find that of Doctor Sharpe; and the *Longipennes* correspond to his *Lariformes*[8], thus:—

	SUB-ORDER.	FAMILIES.	SUB FAMILIES.
Order XVII LARIFORMES.	Lari.	1. Stercorariidæ. 2. Laridæ.	Larinæ Sterninæ Rhynchopinæ

---

[7] Fürbringer, Max, *Untersuchungen Zur Morphologie und Systematik der Vogel*, Amsterdam, 1888.

[8] Sharpe, R. Bowdler, A review of Recent Attempts to Classify Birds. (An address delivered before the 2d Intern. Ornith. Cong., on the 18th of May, 1891.) Budapest, 1891. A most valuable contribution to scientific ornithology, and of great aid to all workers.

and he places his Lariformes between his Alciformes and Charadriiformes. (p. 72.)

My own cabinet contains numerous skeletons of Longipennine birds, and, thanks to the U. S. National Museum, I have had the opportunity of examining very many more.

Recently I have gone thoroughly over this material and written out full descriptions of the characters presented on the part of our American *Longipennes,* and chiefly from osteological data it would seem to me that the following classifications can be sustained as being probably the most natural one.

SUB-ORDER.	FAMILIES.	SUB-FAMILIES.
LONGIPENNES.	LARIDÆ.	Larinæ. Sterninæ
	STERCORARIIDÆ.	
	RHYNCHOPIDÆ.	

So far as our American *Laridæ* are concerned, and it is fair to presume that the fact obtains elsewhere in the world, we observe that certain genera among the Gulls almost insensibly approach in their structure and merge into certain genera of Terns. *Xema sabinii* is closely related to such a species as *Sterna paradisæa,* while *Gelochelidon* comes near some of the heavier built *Larinæ.*

I am of the opinion that the Skuas and Jaegers (*Stercorariidæ,* stand between the *Laridæ* and the *Rhynchopidæ,* being more nearly related to the first named than they are to the Skimmers. Indeed it would seem that the family *Rhynchopidæ* is more remotely related to either of the other two families of the Longipennes, than has heretofore generally been supposed. *Rhynchops* I have shown in a memoir that I have sent to the Journal of Anatomy (Lond.) for publication, is, in some of its osteological characters notably in the skull, the vetebral chain, and pelvis, not very unlike the fossil cretaceous bird *Ichthyornis,* and this is a very remarkable fact.

Through the *Laridæ* of the present SUB ORDER, the Longipennes are found to be not so very distantly connected with the *Alcæ,* the genus *Uria* among the Auks standing between certain Gulls and the more ancient types, such as *Plautus* and

Alca. Huxley has already shown that in another direction "the Gulls grade insensibly into the *Procellariidæ*" (P. Z. S. 1867, p. 445), and it is now generally admitted that through an easy gradation, the osteological characters of a Gull or Tern, pass into those of the Plovers and their allies among the *Limicolæ.*

Beyond the Plovers, we are led on the one hand to the Rails through the *Otididæ,* the Cranes, the *Rhinochetidæ,* and the *Psophiidæ,* while on the other, through other branches we find the Plovers linked by *Hemipodius* with the *Gallinæ.*

EDITORIALS.

EDITORS, E. D. COPE, AND J. S. KINGSLEY.

—In the States of New York, New Jersey, Pennsylvania, Alabama, and some others, the governments have been alive to the importance of retaining in the office of State Geologist a tried and competent expert. In this way they have secured the best results with the least expenditure, and have escaped the inevitable loss which results from changes in the personnel of an expert office. This loss is serious in consequence of the continuous nature of the work of a geological survey. Collections are in process of being formed, and reports of being written, and at no time can a change be made without a loss of work already done, and a loss due to the lack of continuity of work already in hand. Some States have pursued a different course, notably Indiana and Michigan, where competent men were replaced by incompetent men, and the surveys have been of little value since those changes were made. Good geologists competent for both scientific and administrative work are rare, and their excellence is in no way related to their political affiliations.

It is proposed, we regret to learn, to remove from his place the present very competent State Geologist of Illinois, Professor Lindahl. Not only has this officer had an excellent training for the place, but he has already done a vast amount of unpretentious work of the greatest value to the State of Illinois. He not only secured to the State great collections of its minerals and fossils which would have otherwise passed into private hands, but he has reduced them to order, so that they are available to the student and business men of the commonwealth. He is now engaged in making sections across the State with the view of preparing a full and final geological map. The accomplishment of this enterprise can be safely entrusted to the hands of Dr. Lindahl, and he should be supported by larger appropriations than those he has been receiving. He has done much with the limited funds at his disposal.

—M. Gréard has proposed to the French Academy that it authorize a number of changes in orthography. Among these are two which especially commend themselves to writers on scientific subjects, since they relate to words mostly derived from Greek roots. He proposes to abolish the vowel Y, and the diphthong PH, using I in place of the former, and F in place of the latter. These reforms have been before the American public for many years, and their utility is self-evident. If the French Academy of Letters gives them the weight of its authority, we may hope to see them generally adopted. In anticipation of such approval, the Revue Scientifique initiates the movement by writing "fisiologie," "fisiognomie," "psichique," "il i a," etc. (Feb., 1893, p. 175). The American Naturalist will follow the example of the Revue Scientifique so far as it can do so at present consistently with the liberty of action of contributors and other persons, whose prejudices in favor of the old orthography it is necessary to respect.

—It is to be hoped that the present severe Winter has materially reduced the number of English sparrows in this country. Some benevolent persons have been feeding them, and no doubt have thus reduced the mortality to some extent. Such persons should remember that their benevolence is misplaced, since they are sustaining the most active enemy of the farmer known among the feathered tribes. It has been thoroughly proven that the English sparrow is not an insectivorous bird, but that it destroys great quantities of grain and fruit. It also drives away the insectivorous birds, thus doing double injury. It is not even ornamental, and the loss of the beautiful or melodious native species from our parks, which it has occasioned, is greatly to be regretted.

—THE AMERICAN ENTOMOLOGICAL SOCIETY occupies a room in the hall of the Academy of Natural Sciences of Philadelphia. Anxiety has been expressed by some of the members of the former lest they be compelled to vacate their quarters in the Academy Building. On the other hand some of the members of the Academy have expressed some fear lest the Entomological Society vacate voluntarily. Under the circumstances it would seem that both parties have the same object in view. This being the case, cooperation and mutual admiration must be the result, and the satisfaction of both parties be guaranteed.

RECENT BOOKS AND PAMPHLETS.

Aarsberetning, Bengens Museum for 1890. From the Director of the Museum.

Aarsberetning Stavanger Museum for 1891. From the trustees of the Museum.

Administration Report of the Government Central Museum at Madras, 1891–'92.

Allen, J. A.—Description of a New Species of Perognathus from Southeastern Texas.——On a Small Collection of Mammals from the Galapagos Islands, collected by G. Baur. Ext. Bull. Am. Mus. Nat. Hist., Vol. iv, 1892. From the author.

Beecher, C.—Development of the Brachiopoda, Pt. II. Classification of the Stages of Growth and Decline. Ext. Am. Jour. Sci., Aug., 1892. From the author.

Bendire, C.—Life Histories of North American Birds, with special reference to their Breeding Habits and Eggs. Special Bull. No. 1, Smithsonian Institution. From the Natl. Mus.

Beutenmuller, W.—On the Earlier Stages of Some Species of North American Moths, Art. viii. Am. Mus. Nat. Hist. From the author.

Bodington, A.—Life in British Columbia. Ext. Birmingham Post, Jan. 20, 1892. From the author.

Braun, M.—Bronn's Klassen und Ordnungen des Thier-Reichs. Cœlenterata, Echinodermen, Würmer, Gliederfüssler, Vögel, Säugethiere.

Bulletin No. 42, Massachusetts State Agricultural Experiment Station, 1892.

Burckhardt, R.—Das Gehirn von Agathaumas flabellatus Marsh. Separat abdruck aus dem Neuen Jahrbuch für Mineralogie, etc., 1892. From the author.

Cady, A. C.—The American Continent and its Inhabitants before Columbus, Pts. 14, 15, 16. From Gebbie & Co., Publishers.

Cope, E. D.—A Synopsis of the Tiid genus Cnemidophorus. Trans. Amer. Philos. Soc., Vol. xvii, Pt. 1.

Cortazar, D. de.—Descripción Fisica y Geologica de la Provincia de Segovia. Extr. Bol. de la Commisión del Mapa geológico. Madrid, 1891. From the author.

Darewin, G. S.—Synopsis of the Lives of V. C. Woodhull and T. Claflin. From the author.

De Puydt, M., and M. Lohest.—L'Homme Contemporain du Mammouth à Spy Province de Namur (Belgique). From the authors.

Descriptions and Regulations of the West Laurel Hill Cemetery. 1891.

Duges, Alfred.—Ave nueva de Mexico *Dendroica dugesii*, H. K. Coale. La Naturaleza, 2d Series Tomo 2. From the author.

Exposition Rétrospective du Travail et des Sciences Anthropologiques. Sec. 1, Anthropologie-Ethnographie, Paris, 1888.

Garman, S.—The Discoboli, Cyclopteridæ, Liparopsidæ, and Liparididæ. Mem. Mus. Comp. Zool., Harvard Coll., Vol. xiv, No. 2, 1892. From the author.

Gegenbaur, C.—Die Epiglottis. Vergleichend Anatomische Studie. Leipzig, 1892. From the author.

HUNT, T. S.—Systematic Mineralogy Based on a Natural Classification. New York, 1891. From the author.

KINGSLEY, J. S.—The Head of an Embryo Amphiuma. Ext. AM. NAT., 1892, pp. 671–680. From the author.

KRASNOPOLSKY, A.—Carte Géologique génerale de la Russe. Feuille 126. Mémoires du Comité Geol., Vol. xi, No. 1, 1891. Perm-Sohkamsk. From the author.

LECHE, W.—Beiträge zur Anatomie des *Myrmecobius facsiatus.*—Zur Morphologie der Beutelknochen. Ext. Biol. Fören. Förhandl. Verhandl. Biologio. Ver. Stockholm, 1891. From the author.

MACOUN, J., AND N. C. KINDBERG.—Catalogue of Canadian Plants, Part vi. ——Musci, 1892. From the author.

Map of the Madras Presidency. From the Government Central Museum, Madras, 1892.

Monthly Review of the Iowa Weather and Crop Service, Vol. iii, Nos. 2 and 3, 1892. From J. R. Sage.

MOURLON, M.—Sur une réforme à apporter dans les Bibliothiques Scientifiques. Ext. des Ann. des Trav. Pub. de Belg., T. xlix.

——Légende de la Carte Geologique de Belgique. Groupe Quartenaire. From the author.

NEGRI, A.—Trionici Eocenici ed Oligocenici del Veneto. Mem. estr. dal Tom. viii, Serie 3a, No. 7, della Soc. Ital. Sci.

Ninth Annual Report of the Board of Control of the State Agricultural Experiment Station at Amherst, Mass., 1891.

OSBORN, H. F., AND J. L. WORTMAN.—Fossil Mammals of the Wasatch and Wind River Beds, Collection of 1891. Ext. Am. Mus. Nat. Hist., Sept. 1892. From the authors.

POHLIG, H.—Dentition and Kranologie des *Elephas antiquus* Falc. mit Beiträgen über *Elephas primigenius* Blum. und *Elephas meridionalis* Nestl. Extr. Nova Acta der Kgl. Leop.-Carol. Deutschen Akademie der Naturforscher, Bd. lvii, No. 5. Halle, 1891.——Ueber neue Ausgrabungen von Taubach bie Weimar.——Ueber Petersburger fossile Säugethierreste.——Ueber Americanische Proboscidierreste. ——Ueber Glacial geschiebe von Leipzig. Separat-Abdruck aus den Sitzungs-Berichten der Niederrh. Gesellschaft in Bonn. Feb., 1891. From the author.

PILLING, J. C.—Bibliography of the Algonquian Languages. Washington, 1891. From the Smithsonian Institution.

PRESCOTT, A. B.—Address before the Am. Asso. Adv. Science, Aug., 1892. Ext. Proceeds. A. A. A. S.,.Vol. xli.

Prospekt Allgemeine Naturkunde. Leipzig und Wein. From

RUST, DR.—Beiträge zur Kenntwiss der fossilen Radiolarien aus Gesteinen der Trias und der palæozoichen Schichten, Paleontographica. Beiträge zur Naturgeschichte der Vorzeit, herausgegeben von K. A. Zittel. Acht und dreissigster Band. Dritte bis sechste Lieferung. Stuttgart, 1892. From Karl A. Zittel.

RUTIMEYER, L.—Die Eocäne Säugethier-Welt von Egerkingen. Abhandl. der schweizerischen paläontologischen Gesellschaft, Vol. xviii, 1891. Zürich, 1892. From the author.

SAITZEW, A.—Geologische untersuchungen im Nikolai-Pawdinschen Kreise und Umgebung, im Gebiete des Central-Ural und dessen östlichen Abhänge. Mém. du Comité Geol., Vol. xiii, No. 1, 1892. From the author.

SCHWEIGER-LERCHENFELD, U. V.—Das Mikroscope, Wien, Leipzig, 1892. From

SHARMAN, G., AND E. T. NEWTON.—On a new form of Agelacrinites (*Lepidodiscus milleri* n. sp.) from the Lower Carboniferou Limestones of Cumberland. Extr. Quart. Journ. Geol. Soc., May, 1892. From the authors.

SHUFELDT, R. W.—Notes on the Blowing Viper. Ext. Great Divide, July, 1892. From the author.

SIEBENROCK, F.—Zur Kenntwiss des Kopfskelettes der Scincoiden, Anguiden und Gerrhosauriden. Separat abdruck aus Band vii, Heft. 3, 1892. From the author.

Specimen Map from W. and A. K. Johnston's School Atlas of Physical Geography, 1892. From W. and A. K. Johnston.

Third Annual Report of the Missouri Botanical Garden, 1892. From the Board of Trustees.

TROUESSART, E.—Les Primates tertiares et l'homme fossile sud américain. Extr. L'Anthropologie Mais Juin, 1892, No. 3. From the author.

TUCKERMAN, F.—On the Terminations of the Nerves in the Lingual Papillæ of the Chelonia. Aus der internationalen Monatsschrift f. Anat. u. Phys., 1892. Bd. ix, Heft 1.

——The Gustatory Organs of *Ateles ater*. Extr. Journ. Anat. and Phys., Vol. xxvi. From the author.

RECENT LITERATURE.

Memoirs of the National Academy of Sciences, Vol. V.— The memoirs of 1891, five in number, are published in the usual quarto form under the following titles: Energy and Vision, by S. P. Langley; Contributions to Meteorology, by Elias Loomis; Report of Studies of Atmospheric Electricity, by T. C. Mendenhall; The Embryology and Metamorphosis of the Macroura, by W. K. Brooks and F. H. Herrick; On the Application of Interference Methods to Astronomical Measurements, by A. A. Nicholson. The illustrations are numerous and good.

Brooks and Bruce on the Embryology of the Macroura.[1] —The two hundred and fifty quarto pages of this memoir are not easily summarized in a page or so of THE NATURALIST, for they include a wide range of subjects. After an introduction by Professor Brooks comes an account of the life-history of *Stenopus hispidus* by Professor Herrick; next the habits and metamorphosis of *Gonodactylus chiragra* by Professor Brooks; fourth the Metamorphosis of *Alpheus saulcyi* by Brook [*sic*] and Herrick, while the bulk of the volume is taken up by Dr. Herrick's paper: Alpheus, a study in the development of the Crustacea, which extends from page 371 to the end.

The most interesting facts connected with the reproduction of the almost cosmopolitan Stenopus are the hatching of the larva as a protozoæa with enormous mandibles and its later metamorphosis into a larva with an enormously developed fifth pereiopod, the use of which as a swimming organ has doubtless played an important part in the wide distribution of the species.

Much more important are the observations on Gonodactylus, for every fact concerning the early embryology of the Stomatopods is a positive addition to knowledge. Gonodactylus, like the others of its tribe, deposits its eggs at the bottom of its burrows, where they are aërated by the currents produced by the pleopoda of the parents. From these eggs the young hatches in an advanced condition, five abdominal segments with their appendages being outlined before the young escapes from the chorion. Professor Brooks was enabled by this material to conclusively show that the larval Stomatopod to which he had previously given the name Gonerichthus is the young of Gonodactylus.

---

[1] The Embryology and Metamorphosis of the Macroura, by W. K. Brooks and F. H. Herrick. Memoirs Nat. Acad. Sci., Vol. v, pp. 321–576, 57 pls. Washington, 1892.

The account of the various species of Alpheus is most detailed and one of the most striking facts brought out is that the same species in different localities may have an almost totally different development. Thus, in the Bahamas, *Alpheus heterochœlis*[3] hatches from the egg with all its appendages functional as far back as the third pair of maxillipeds, while the pereiopoda 1, 2, and 5 are bud-like rudiments, and the joint between abdominal segment 6 and the telson has not appeared and no pleopoda are outlined. At Beaufort, N. C., the species is much more advanced before leaving the egg, but the stage at which it hatches is not directly comparable with any stage in the life history of the Bahaman form. At hatching all the appendages of the adult are present, and all become functional after the first molt. In the Bahamas there is a long series of larval stages, while at Beaufort there is a great acceleration, and even this is not all; the Beaufort stages are so modified that at no time can exact parallels be drawn between them and the more southern form. In the Bahamas there are three, then four, then five, and then seven schizopodal feet with functional exopodites, while at Beaufort there are never more than three. Yet these different types of metamorphosis result in the production of adults which are almost exactly alike. It must be noted that Packard has described still another type of development for what he regards as the same species at Key West. For the details of the development of the different species of Alpheus studied we have but little room; those interested must seek the memoir itself. The segmentation in *A. saulcyi* and *A. heterochœlis* is typical centrolecithal, with the formation of yolk pyramids; in *A. minus* it is irregular and has no yolk pyramids, but the statement (pp. 427 and 457) that it is amitotic deserves further investigation. All of the nuclei resulting from segmentation migrate to the surface and there by delamination they produce " wandering cells " which pass into the yolk and give rise to both mesodermal and entodermal structures. The subject of degeneration of certain nuclei is also very interesting. Dr. Herrick has carefully followed the increase of nuclei in the various parts of the embryo, and has plotted curves illustrating the distribution of primary yolk nuclei, of wandering cells, and of all other cells, from which the reader can almost reconstruct the eggs for himself.

---

[3] There is a great diversity in this memoir as to the spelling of various scientific terms. Thus we have usually *heterochelis* regardless of the fact that Say, who described the species, wrote *heterochœlis; Alpheus minus* appears as *minus, minos* and *minor;* centrolecithal sometimes as centrolycethal; Lucifer as Leucifer.

Only a few points more can be noted in the later history. The mouth invagination occurs on a line between the bases of the antennular buds; the history of the eye is followed, the author agreeing well in most points with Parker, but affording little support to Watase's theoretical views. The antennal gland (green gland) is regarded as mesodermal, but its opening was not found even in the larval stages; the alimentary canal proper is almost wholly made up from stomodeal and proctodeal invaginations, the true entoderm, which arises by the migration of yolk cells to the posterior end of the yolk being chiefly confined to the hepato-pancreatic diverticula and their ducts.

The greatest fault which one can find with the paper is that which is due to its composite nature, the result being an apparent lack of arrangement, so that it is difficult to follow in detail certain structures. This possibly was unavoidable where two authors were each contributing their parts and also where the composition of the text was done at different times. The volume is filled with valuable facts and cannot be ignored by the student of Crustacean ontogeny. It is by far the most valuable zoological memoir yet published by the National Academy.

Campbell's Biology.[3]—It is rarely that such a veritable hodge podge as this comes to our table. It is an example of absorption without assimilation on the part of the author. The plan of the work is fairly good but it is a misfortune for any student to have it as a guide in his studies. It is worse than the notorious works by the late Dr. Steele, for their faults were largely negative; they taught absolutely nothing good or bad, but this is "filled with lots of things that are not so." The work intends to be a companion to the laboratory work, and gives much space to protoplasm, the cell and the like, and then takes up without any apparent order the structures and classification of animals and plants. A few passages out of over a hundred which we have marked will illustrate the chief shortcomings of the work.

P. 137. The lungs "develop as an outgrowth of the alimentary canal. This outgrowth becomes completely separated off from the oesophagus, and at its lower end divides into two or more tubes, which communicate with the pharynx by a single tube, the trachea."—Pp. 145–6. The statement is made without a single qualification that the ureter of vertebrates is developed from the ectoderm and in the development of the nephridia "as a rule the ciliated funnel which was present during development, becomes completely closed." P. 85. Between the ectoderm and the entoderm of the sponges "is a gelatinous layer, the mesoglœa, amongst the cells of which crystals of lime salts occur," which we suppose to be the spicules, silicious as well as calcareous, of these organisms. · P. 83. The animal kingdom is divided into Protozoa, and Invertebrate and Vertebrate Mesozoa. The Invertebrates are defined as follows: "They possess no backbone, the nerve cord or nerve cords are never dorsal, . . . and the heart is always placed in the dorsal region." The Invertebrata are subdivided into Cœlenterata and Cœlomata, but never a word that the Plathelminthes are not Cœlomata and that the vertebrates are. But enough. The work is well illustrated, mostly by cuts from Claus, Sachs, Prantl and other recent text-books.

---

[3] Text book of Elementary Biology, by H. J. Campbell, M. D., Lond. London, Swan Sonnenschein, New York, Macmillan & Co., 1893. 12 O., pp. xii + 284.

Correlation Papers of the U. S. Geological Survey Neocene.[4]—This memoir is the fifth of a series, having been preceded by essays on the Carboniferous and Devonian by Mr. Williams, on the Cambrian by Mr. Walcott, on the Cretaceous by Mr. White, and on the Eocene by Mr. Clark. To an excellent summary of published material on the subject discussed the authors have added important original matter based on personal investigations by Mr. Dall in the field and laboratory. The following is an outline of the memoir as given in the introduction:

"This paper, after discussing general principles connected with the study and description of the Tertiary or Cenozoic rocks and fossils contained in them, takes up the Neocene deposits of the United States in particular.

"A chapter is devoted to a summary of what is known in regard to the Neocene of the eastern coast of the United States, each State in geographical order being separately considered, beginning at the north. The State of Florida, in regard to which much unpublished information was available, being entirely composed of Cenozoic rocks, and therefore as a type of such structure peculiarly interesting, is treated of in greater detail and at more length than in other cases. The part of this essay relating to the State of Florida is really a preliminary geological report on that State, of which the structure has hitherto been very little known. The important fact that until the Pliocene period, Florida, so far as it was elevated above the sea, was an island separated from the mainland by a wide strait, is here first demonstrated. It is also shown that the strata are probably gently folded lengthwise of the peninsula, and that in the trough now occupied by the "lake region" of Florida in Pliocene time a large lake probably existed, to which the name of De Soto has been applied. The age of the remains of fossil vertebrate animals, which in south Florida are associated with the so-called "pebble phosphates," is here definitely determined."

---

[4] Bulletin of the United States Geological Survey No. 84. Correlation Papers—Neocene, By W. H. Dall and G. D. Harris. Washington, 1892.

After discussing by States the character and distribution of the Atlantic Neocene, a chapter is devoted to the consideration of the general geological movements and fluctuations of land, sea, currents, and water temperatures which appear to have been concerned in producing the characteristics described.

"In like manner the Neocene geology of the Pacific coast has been treated, and in addition to that of California, Oregon, and Washington, a synopsis of data relating to British Columbia has been included, together with a summary of what is known in relation to Alaska during this epoch. The latter discussion contains a large amount of material extracted from unpublished notes covering some fifteen years' study and exploration by W. H. Dall in the Alaskan region, and therefore adds materially to the sum of our knowledge in regard to that part of the United States.

"The Great Interior region of the west is then taken up, and a summary of our knowledge in regard to its Neocene geology is brought together for the first time. While this is necessarily far from perfect, the very fact that such gaps exist will stimulate the collection of information to supply the missing links.

"The essay closes with a list of names proposed for geological beds, groups, and formations in the American Cenozoic strata, and a description of the data upon which the coloration of the general map is based."

The work while an eminently important and useful one, is very unsymmetrical, as the authors themselves recognize. They are very full in describing the formations that they have seen, those of Florida, for instance, and deficient in those which they have not seen, as the lacustrine formations of the interior. The latter yet remain to receive adequate treatment from the U. S. Survey, since to do this requires the aid of a competent paleontologist of the vertebrata.

The geological map of Florida contained in this volume expresses clearly the latest discoveries in that state. The coloration will surprise geologists who supposed that Major Powell had abandoned his extraordinary position on the question of coloration of geological maps. We seem to see in Florida a good representation of the Archean, Paleozoic and Mesozoic beds, as well as the Cenozoic. For this Mr. Dall is in no way responsible. It is a pity that expense should be incurred in printing such maps, since they will have to be republished with the customary colors.

Cary on the Evolution of Foot Structure.[5]—We have in this paper a study of the fore foot of Palæosyops, from a specimen in the museum of Princeton College, conducted with a view of ascertaining the mechanical relations of the parts when in action. The ultimate object is to determine whether the structures presented (facets, etc), can have been produced by direct mechanical impacts, strains, etc., as is alleged by the Neolamarckian school of evolutionists. The study is conducted with care, so far as it goes, but it is not always easy to understand the drift of the author's argument. He reaches but one definite conclusion, viz.; that the trapezoid is too small to express properly a result of direct mechanical causes. This fact, the author says is incompatible with the Lamarckian principle. He informs us that in reaching this result he has applied geometrical methods. "First, the volume of the bones was got at. Next the area of the bearing surfaces and their inclination to the digits were measured. Then giving to the thrust of each metacarpal a value proportional to its volume, the distribution of that thrust can by resolution and composition of forces, be traced through the foot, and the pressure on each surface and bone approximately obtained." Further than this the author does not explain how he reached the result that the trapezoid is too small. It is quite essential that this demonstration should be given if we are expected to accept his conclusion. An essential part of the problem is, however, unnoticed by Mr. Cary; and that is the condition of the trapezoid in the reptilian ancestors of the Mammalia. The phylogeny of an element must be known, since it furnishes the "physical basis" of the problem.

Mr. Cary then proceeds to criticize the explanations offered by Professor Osborn and myself, in accounting for the origin of certain structures. He finds our explanations to be self-contradictory, and that we also contradict each other. Osborn has supposed that the conules of the molars are produced by friction of the molars of opposite series on each other. I have expressed the opinion that the shear of the sectorial teeth of Carnivora was produced by lateral friction during vertical movement of the lower tooth on the upper. I have also asserted that the forms of facets of limb articulations are due to pressure. Mr. Cary sees here the attempt to explain the origin of totally different structures through identical mechanical processes, and believes that the attempt is a failure. Were the conditions of the problems alike, as Mr. Cary thinks them to be, he would have good reason for this opinion. But the conditions in the three cases are entirely different, and our author's conclusion is due to neglect of the elementary facts of the proposition.

---

[5] A study in Foot Structure; by Austin Cary. American Journal of Morphology Dec. 1892, p. 305.

The development of conules at the points indicated by Professor Osborn, has been supposed by him to be due to friction between existing ridges of enamel which cross each other when in action, at the points in question. In the case of the development of the sectorial shear, the faces between which the shearing motion takes place are smooth, and without ridges or crests. Hence the entire surface receives a homogeneous friction. In the third case, that of the foot articulations, there is no friction, but there is pressure which when abruptly applied in movement becomes impact. There is really no parity between the three cases.

The author of this paper also thinks that the explanation of the elongation of bones through use of different kinds is not a permissible hypothesis. He cites my attempt to account for the elongation of the leg bones of higher mammals through impact-stimulus; and of other limb bones of other mammals through stretching. But he does not prove that similar results may not flow from mechanical stresses applied in different ways. I suppose that any mechanical stress which determines nutritive processes to a part, will increase its size, caeteris paribus ; and the stretch as well as the impact has this effect.

Use is a term which is too indefinite for purposes of exact demonstration, and I have endeavored to reduce it to precision so far as regards the skeleton, by defining it as "friction, pressure and strain." Precisely how these processes affect nutrition is not yet clear. We refer the production of various animal fluids to "secretion", knowing that the products of secretion are most various, as bile, gastric juice, saliva, etc. The exact cause of the diversity remains unknown. So with the effect of stimuli on bone nutrition, we see the cause and the effect, but the ultimate process, as in all nutrition, has as yet eluded our view.

In concluding, Mr. Cary admits one of the two contentions of the Neolamarckians in his two closing propositions. He says "Plasticity of bone, using the word *plasticity* not in a physical sense merely, but to include absorption under pressure, will probably account for much structure in the foot and elsewhere, especially the connection with the joints, and in the fields of variation and correlation." In the second proposition he says that facts have been adduced by him which are inconsistent with the theory that the size of bones has been increased by the stimulus they receive, and with the theory that regions of growth are determined by regions of pressure and strain. "The testimony of the literature as to the latter point he says is conflicting." I have shown that the supposed conflict is due to a misunderstanding on the part of the author of this paper. The proposition that pressure does not affect growth is in contradiction to the admission made by the author in his first proposition, where he admits that pressure determines structure; for in such change of structure there is always growth. Finally Mr. Cary remarks "That race changes follow those produced in the individual life, or that they are directly caused by their mechanical surroundings, I do not think it has been satisfactorily shown." The fact that the characters of bone structure admitted by Mr. Cary to have had a mechanical origin appear in the young before birth, is evidence that race characters are produced, and that they are produced by mechanical surroundings.

Such criticisms as are contemplated by the author of the paper reviewed above, are important and are what the subject needs. It is along the line followed by him that the ultimate demonstration of the problems involved will be made. We trust that we shall hear from him again in this field, and that in his labors he will be well supplied with the phylogenetic details as a foundation.

E. D. COPE.

Earle on the Species of Coryphodontidæ.[6]—In preparing this paper Mr. Earle had the advantage of the use of the material in the collections of the New York American Museum of Natural History, and the private collection of Professor E. D. Cope. He presents us with a brief résumé of the results of his comparisons, and adds considerably to our knowledge of the characters of the skeleton and dentition of some of the species. He gives a list of the described species, which number twenty-one, and which were referred by Cope to five genera. He concludes that these should be reduced to ten species and three genera, viz., Coryphodon Owen, Ectacodon Cope, and Manteodon Cope.

---

[6] Revision of the species of Coryphodon, Art. xii, Bull. Am. Mus. Nat. History New York, iv, pp. 149–66; Oct. 18, 1892.

Mr. Earle's conclusion that the supposed genus Bathmodon is not distinct from Coryphodon may be well founded, as the material at his disposal is better than mine. The difference in the forms of the astragali of the two types is, however, greater than is usual in a single genus, and is seen in material from all localities. The character on which the genus Metalophodon rests is a strong one, provided it be constant. Mr. Earle says it is not constant, and if his material demonstrates this to be the case the genus must be abandoned. I do not, however, think that he demonstrates his case in the paper under review.

Let us now see the evidence on which he reduces my reputed twenty-one species to ten.[1] In the first place he fails to state that I had already reduced two of the names to the rank of synonyms, leaving nineteen species to my credit; that is to say, nine specific names remain which are alleged to be superfluous. One of these is, however, admitted to be good by Mr. Earle. He refers *C. simus* and *C. latidens* to *C. elephantopus*, but says also that the former two are "quite radically distinct." Both cannot, therefore, be synonyms of the same species unless "things *not* equal to one another are equal to the same thing." I described the lower molars which probably belong to the *C. elephantopus*, and they are totally different from those of the *C. latidens*. The superior last molar of *C. simus* is different from that of the *C. elephantopus*. The three species are in my opinion well distinguished. This reduces the supposed superfluous names to seven.

Mr. Earle does not admit the *Metalophodon armatus* for reasons which are insufficient. As I took the greater part of the dental series from one decayed skull, and an almost equally large series from a second skull, and as the two series confirm each other, I believe the species to be one of the most distinct of the family. This reduces the supposed excess to six. As to the *C. cuspidatus*, the last inferior molar teeth of three individuals are now known, and they confirm each other not only by their characters but by their inferior size. Mr. Earle admits this species with doubt. The *C. marginatus* is rejected by him as probably founded on a milk tooth of *C. anax*. But it is not a milk tooth,[6] but an unworn permanent tooth of a species of hardly half the bulk of the *C. anax*. Coryphodon did not possess milk teeth of this form. The surplus is now five names. There are three forms of approximately similar and smaller size, viz., *C. latipes*, *C. molestus* and

---

[6] I have represented the milk dentition of Coryphodon on Plate liv, fig. 3, of the U. S. G. G. Survey, Report Capt. Wheeler, iv, 1875.

C. simus, which Mr. Earle refers to the *C. elephantopus*, but of which the second and third do not exhibit the form of the last superior molar which he regards with me as characteristic of the latter species. It is not unlikely that *C. simus* and *C. molestus* are one and the same, but the evidence is not yet in favor of their being identical with the *C. marginatus*. It is probable that these specimens represent at least one distinct species of rather small size.

In conclusion I think that Mr. Earle has been hasty in his wholesale reductions, and that instead of ten species in the American Wasatch beds there are at least fifteen recognizably described. It is evident that more material and more research are necessary before a larger number than this can be demonstrated and before those which are admitted can be fully defined. A considerable part of Mr. Earle's conclusions may be due to the fact that, as he says, he has "labored under the disadvantage of not being able to study any of the types of Coryphodon from New Mexico which have been described by Professor Cope."

The Coryphodontidæ were the predominant type of the Wasatch (Suessonian) Eocene, and they were probably numerous in species and varied in character. If the bones and teeth of the existing African antelopes were mixed up and discovered piecemeal, they would puzzle naturalists, who would at first be incredulous as to their representing over forty species.—E. D. Cope.

General Notes.

GEOGRAPHY AND TRAVELS.[1]

Africa.—Garenganze.—Garenganze, the land ruled by Mshidi, between Lakes Mwero and Tanganyika, has recently been visited both from the east and from the west. Mr. Alfred Sharpe, proceeding from Lake Tanganyika, discovered west of that lake and east of Mwero another Mwero into which run the rivers Mkabe, Mwambezi, the Choma from the north, and the Chisela from the north-east. This lake is now partially desiccated, and consists of an extensive salt-marsh with several pools of water, including a large central one about fifteen miles long by ten wide. The former outlet of this lake was by the Movu river-bed to the Kalongwizi River, a feeder of Lake Mwero. Kazembe, the powerful chief who resides on the Luapula, above Lake Mwero, though very polite to the traveller, would not permit him to cross because of his enmity to Mshidi, so that, finding all attempts useless, Mr. Sharpe was compelled to retrace his steps to Abdallah's near the salt-marsh, and from thence to make his way westward round the north of Lake Mwero. Abdallah is an agent of the famous Tippo Tib, and bears sway eastward as far as Kabunda, near Tanganyika. The highest point between Chipenbiri, on the level of the swamp, (3050 feet) and Lake Mwero, is at an elevation of 3850 feet. The eastern watershed of the northern part of Mwero is not more than six to eight miles from the shore, and that lake is 2900 feet above the sea. The streams Luao and Luchinda flow into the lake from the north, and Mpweto's town, east of the Luabula, is subject to Abdallah. The Luapula, at its point of exit from the lake, is of less volume than above. Beyond the lake rises one of those plateaux so frequent in Africa, and the country beyond this, after passing Chuako (subject to Mpweto), belongs to Mshidi. The Luvule River falls into the Luapula not far from its exit, and the next river reached after crossing the watershed is the Luvula, an affluent of the Lufira, into which it falls a few miles above the junction of the Lufira with the Likulwe, from its left bank. The Lufira itself like the Lapula, is a tributary of the Congo. The soil of Garenganze is rich, but the country shadeless. Mshidi is now an old man; originally he was a trader from the Wa-Nyamyezi, but became chief. He has many wives. On his return by the same route that he had entered, Mr. Sharpe explored the salt-swamp, and found it rich in large game. Lake Bangweolo is placed at 4260 feet above sea-level; thus, as the sources of the Chambezi are only 4400 feet, the fall of that river must be very slight. Our traveller states that the practice of maiming the person is rife among the natives southwest of Tanganyika, among whom the Wa-Wemba are perhaps the worst in this respect.

---

[1] This department is edited by W. W. Lockington, Rugby, England.

The visitor to Mshidi from the west, was Lieutenant Paul Le Marinel, the service of the Congo State. The route necessitated the crossing of the Sankuru, Lomami, and Lualaba basins. The first is situated further to the east than has before been supposed, and the travellers discovered the Luembe, an affluent of the Lubilash, itself a tributary of the Sankuru. The source of the Lomami was found in 8° 45′ S. and 24° 55′ E. long; the river occupies a long narrow basin, running almost due north and south for 750 miles. During the whole of this course it does not stray more than a degree from a straight course, and it receives only two important tributaries, the Lurimbi and the Lukassi. South of the plateau in which the Lomami rises, is a district named Samba, with a most European aspect. Marinel gives Bunkeia as the name of Mshidi's capital. East of the Lualaba the country is mountainous.

AFRICAN NOTES.—One of the chief discoveries of Dr. Stuhlmann, who last year accompanied Emin Pasha into his old Equatorial province, was the river Kifu, which is stated to have a course of 250 miles before it falls into Lake Albert-Edward, and is thus the most southerly source of the Nile yet known. Dr. Stuhlmann started from Kafure, on the Muta, a tributary of the Kangere, on the west shore of Victoria Nyanza, descended to the Kagere, then crossed the Mpororo Mountains to the Ruchuru and to Lake Albert-Edward (Mwutanzige) at Vichumbi (0° 44′ S., 2850 feet). The country to the south was a vast savannah with mountains in the distance, among which Kisigali, 13,000 feet, seems to be the highest. Beyond this is the active volcano of Virungo Viagongo. Along the west shore of the lake the mountains approach almost to the edge. From Karevia he attempted to ascend the snowy mountain (probably a peak of Ruwenzori), and reached 12,500 feet. He found bamboo and grasses from 3850 to 5350 feet; colocasia beans, grass, and the upper settlements up to 6700; then deciduous forests with Erica and bamboo to 8530 feet, followed by a belt of Erica and Vaccinium to 11,800, above which, to the snow line at 13,000 feet, the vegetation was reduced to mosses, lichens and

Senecio. The plateau west of Lake Albert is known as Lendu. He reports a considerable shrinkage of the waters of the Albert Nyanza since it was first discovered, so that islands have become peninsulas.

M. Crampel and his party was set upon by Snoussi and his fanatical Arabs, who killed all the whites, asserting that they had no business in the country, but did not hurt the Senegalis who composed his escort. M. Nebout, who was coming up, carried back the sad news, and the fate of Crampel was avenged by M. Dybovski, who entered the country with a considerable force.

On the Mobangi, Captain Van Gele has "forged the last link" between that river and the Welle, which is thus definitely included in the Congo basin.

The Kong Mountains of the maps have been found to have no actual existence, proving to be but an elevated watershed.

The Italians are endeavoring to explore Somaliland, but some of their recent expeditions have not been successful. Captain B. de Vesme, however, passed from Berbera by Harrar, over the waterless plains of Milmil to the rivers Kishen and Amaden, and then to the upper course of the Webbe.

America.—THE ECUADORIAN ANDES.—Dr. Wolf, who has devoted much time to the study of the Andes of Ecuador, describes them as consisting of two ranges, connected at intervals by cross chains, and thus enclosing basins. The eastern cordillera is as a whole more prominent, geologically older, and of greater average height than the western, the rocks of which are much more heterogeneous, while its elevation exhibit greater diversity and irregularity. A porphyritic cross ridge at the mountain knot of Acayana and Guagrauina has much gold-bearing quartz, and is the richest mining district of the country. From this the eastern cordillera continues onward, broad and lofty, into the province of Cuenca, with a wide bend, and a second cross ridge of porphyry forms the knots of Portete and Tinajillas. The lofty basin of Cuenca is one of the most beautiful in the Andes, and the chief town is situated at an altitude of 8460 feet. North of there is the irregular mountain mass of Azuay, which sends spurs in every direction, two of which reach the western cordillera. Beyond this the eastern cordillera becomes of greater extent, and rises into the gigantic volcanoes of Sangay (17,880 feet), the most active volcano in the world, Altar, or Collares (17,710 feet), and Tunguragua, (16,696 feet). Opposite to these, on the western cordillera, rises the still loftier Chimborazo (20,660 feet). Here commences a third cordillera, parallel with and geologically resembling the western range. The waters of the Lacatunga basin flow south and burst through the eastern range. The drainage of the basins of Quito and Ibarra goes to the Pacific. The western cordillera, by the Quito basin, is quite low, not more than 10,000 feet, but is raised by superimposed volcanic rock into the lofty volcanoes of Corazon, (15,804), Atacoza, (14,390) and Pichincha. The eastern cordillera is here more complicated, and bears the giant volcanoes of Cotopaxi (19,480), Sincholagua (16,360), Antisana (18,885) and Cayambe (19,450). Northward the eastern range is continued into Columbia, increasing in height and breadth, but without any volcano north of Cayambe. In the province of Quito the western range rises into the volcanoes of Cotocachi (16,295) and Yanaurai (14,000.)

Both Dr. Wolf and Mr. Whymper describe travelling in the Ecuadorian Andes as depressing in the extreme. The lower regions, up to ten thousand feet, are thickly covered with a forest, within which it rains forever, the home of fever and dysentery. The higher regions are relatively healthy, but past expression dreary, all the more or less rounded heights being covered with coarse brown olive paramo grass, and presenting quite a contrast to the picturesque ruggedness of the Alps. These bleak paramos, as the tracts 10,000 feet or more above the sea are called, are poorly populated and badly tilled, while the huts are windowless and the people in rags. Here and there are fertile valleys with forest in sheltered spots. The temperature has little variety, ranging from 39° to 46°.

Mr. Whymper describes the climate of the paramos as a perpetually wet afternoon, and speaks of Chimborazo as a long extinct volcano, and states that the existing centres of volcanic activity are Cotopaxi and Sangai. The whole of the Andes of Ecuador are, according to Dr. Wolf and Mr. Whymper, situated more to the east than they are shown on Humboldt's and other maps.

THE UCAYALI.—The Ucayali, generally considered the leading affluent of the Amazon, has been found to be navigable for 1040 miles. The junction of the Perene with the Ene forms the Tambo, and that of the Tambo with the Urubamba forms the Ucayali. The Perene, which curves westward toward the Andes, can be navigated ten miles above its junction with the Ene, while the Huallaga, a large tributary to the north, can be entered by large steamers to 100 miles from its mouth. Iquitos, on the Amazon, on the frontiers of Peru and Brazil, is 350 feet above sea level, the mouth of the Ucayali 370, that of the Tambo 800, and that of the Ene 1000 feet. The native population of the Ucayali Valley, according to Col. Church, is not more than forty thousand, and this is as many as can be supported with their modes of life. Life is not plentiful; fish are scarce in the waters, and in correlation with this, birds are not abundant. The natives cannot procure iron. The eastern slopes of the Peruvian Andes are clothed with thick forests, among which cinchona trees abound.

Asia.—THE PAMIRS.—During the last few years much has been written about the Pamir, a region the very name of which was unknown until recently. Many travellers have found their way across this now celebrated plateau, or rather congeries of plateaux, which may be considered to form the western and narrower end of the great Tibetan table-land, the knot, in fact, from which the bounding ranges of that plateau take their origin. Among its late visitors have been the Frenchmen Bonvalot, (in company with the Prince of Orleans), and Sauvergne, the Russian Grombchevsky, the Englishmen Younghusband and St. George Littledale, accompanied by his wife. The main object of the latter seems to have been the destruction of *Ovis poli*, yet they could scarcely avoid adding to our knowledge of this not readily accessible tract.

The Pamir, or rather Pamirs, for there are several, the Little Pamir, the Great Pamir, that of Tagh-dum-bash, Alichur Pamir, and Sarikol, consist of a series of flat valleys surrounded by mountains, the really lofty crests of which do not rise greatly above the level of the valley streams.

The Pamir is situated at the junction of three great empires, and the ownership of the comparatively barren region may lead to war. The lake on the Great Pamir has been named Victoria Lake, but is called by the Kirghis, Gaz Kul, a name also given to two or three other lakes. Victoria Lake is 13,980 feet above sea level, while the Khargash Pass to the north is 14,500 feet, and the Andenin Pass, between it and the Little Pamir, 15,500 feet. The Pamir River from this lake flows west into the Wakhan, which seems also to bear the name of Kala-i-Panj, and which, after its junction with the Murghab, becomes the Amu-Daria or Oxus. The Little Pamir Lake is said to be 13,850 feet above sea level, and its outlet is by the Aksu, which, after running north-east until it has rounded the Great Pamir, unites with the Aik Bailul to form the Murghab affluent of the Oxus, flowing through Roshan Valley. Between the westerly courses of the Wakhan River and the Murghab flows the Ghund-Dara, the chief sources of which seem to be Lake Yashil-Kuhl and the Alichur River—the valley of the Ghund-

Dara is known as Shignan. Littledale's encampment on the Alichur Pamir, was at a height of 13,625 feet. Lake Kara Kul, north of the Akru-Murghab, is 12,400 feet above the sea.

East of the Great and Little Pamirs are Tagh-kum-bash and Sarikol, the streams from which, among them the Markhan-su, flow into the Kashgar and Yarkand Rivers, and thus geographically fall to China, which has, in fact, raised her banner on the Sarikol plateau. The two maps which have been published in the Proc. Roy. Geog. Soc. during the past year exhibit differences in the course of these affluents.

The important range of the Hindu Kush separates the Chitral and Hunza district from the Pamir and more northern valleys. This range is crossed by the extraordinary depression, two to three miles wide, known as the Baroghil Pass (12,480 feet). Through Chitral Valley flows the Yarkhun River, rising in a small lake bearing the title of Gaz Kul, and flowing somewhat south of west toward the Indus. Close to this Gaz Kul, even if not occasionally united with it, is another small lake, from which issues the Karambar River, which with the Gilghit and Hunza Rivers, join the higher course of the Indus, where it flows toward the west, before bursting through the Himalayas. The western part of this Indus-draining region is known as Chitral, and is situated at an average elevation of 5200 feet on the southern slopes of the Hindu Kush, amid spurs from fourteen to twenty-five thousand feet above sea level. On the south it is bounded by the petty States of Asmar and Dir. The valley is reputed to be very fertile, and is said to have a population of a hundred and fifty to two hundred thousand, without reckoning the Bushgali Kafirs. The Mehtar or Badshah of Chitral, is said to be able to bring into the field 6000 fighting men, all careful marksmen. Chitral, about 150 miles from the town of Gilghit, is an aggregation of six large villages situated along the river, which in the Geographical Journal is called the Kashkar. The names Yarkhun and Kashkar seem to be identical with the Yarkana and Kashgar of Chinese Turkistan.

Mr. and Mrs. Littledale reached the Pamir region via the Russian Trans-Caspian railway. The route from Samarkand to Marghilan, the capital of Kokhand, is described as an alternation of barrenness with gardens of Eden. Continuing southward, they followed the Gulcha River and crossed the Alai plateau over the Little Alai range. Through the passes of Taldik (11,600), Shart (12,800), Terek (over 12,000), Kalin Art (10,800) and Kizil Art (14,200), they reached Kara Kul Lake, and then, after encamping within sight of Lake

Yashil Kul, crossed the Great and Little Pamirs, and proceeded through Baroghil Pass to Chitral, Darkot and Yasin, whence they made their way to Gilghit. From the Great Pamir they enjoyed a view of magnificent mountain peaks over 20,000 feet high. They describe the Pamirs as flat valleys, with lakes having low shelving banks; barren areas with little grass. In Chitral the climate was much better, the warmth and the abundance of apricots contrasting sharply with the barren coldness of the Pamirs.

D. W. Freshfield thus speaks of the Pamirs, after stating that the different strips of table-land form a district 280 miles long, from 120 to 140 wide, and twelve thousand feet high, "tent-shaped glacier-covered mountains divided by broad easy gaps, bare heights naked of verdure and shorn of forests by bitter winds and frosts; desolate lakes, a region which for the most part has neither fuel nor food; an Engadine of Asia, with nine months of winter and three months of cold weather; the home of wild sheep and that of a few wandering shepherds; nomads' land if not no man's land." The Chinese name for the district signifies the "half-way house to heaven," while the word "Pamir" appears to be a Turki term for a plateau. Grombchevsky gives a more favorable account of the district. Wakhan, Shignan and Roshan are at present claimed by the Amir of Afghanistan. Mr. Younghusband found his way to Hunza in 1889 and to the Pamirs in 1890. Between Leh and Hunza, or Kanjut, four passes, from 17,500 to 18,500 feet high, must be crossed, amid glaciers and the grandest scenery. The home of the robber Kanjuts, or Hunza, (in which latter name some think to find the origin of the Huns), is eastward of Chitral. The villages of the Hunza are stone-walled forts, the entrance into which would be difficult if resisted. The sovereign, who made his way to power in good old Oriental fashion, by the murder of his relatives, owes allegiance to the Maharaja of Kashmir. The Taga-dumbash Pamir descends as low as to 800 feet.

Another recent traveller in this region is the Frenchman Dauvergne, who entered by Srinagar and Leh, over the Karakoram Pass to Sanju Kurgan, took a new route to the sources of the Oxus, crossed Baroghil Pass into Chitral, and then through unexplored passes found his way into Karambar Valley, and via Gilghit back to Srinagar. Beyond Kilian Pass (17,450), at Namelong, Dauvergne turned west and reached Kugiar Valley by the following passes, Namelong (12,140), Saraghar (13,250), Tuslar Dawan, (14,500), Tupa Dawan (15,400), (a great opening in a chain parallel to the Kuen Lun, not yet marked on the maps, with peaks sixteen to nineteen thousand feet in height); Sanich

Dawan (16,170), and Kichokin Dawan, a double pass, 15,300 feet above sea level. The Tisnaf Valley, Egisarak Kurgan, where copper is found, the village of Langar on the Zarafshan, an affluent of the Yarkand, are other points in his journey. He followed the Zarafshan to its junction with the Tung, and then turned S. S. W. to the plateau region, where he reached 16,350 feet. According to him, the real sources of the Oxus are those of the Panjah. The difficult Karambar Pass was crossed with ten horses.

Australasia.—THE GLACIERS OF SOUTH NEW ZEALAND—The glacier region of the southern island of New Zealand has been to a great extent explored during the last thirty years. The smaller glaciers, which lie north of the larger, were first visited, the earliest visit to the latter being that of Sir J. von Haast in 1862. After his exploration of the headwaters of the Godley and Tasman rivers, came the visit of E. P. Seely between 1867 and 1870. Little more was done until 1882, when the Rev. W. S. Green almost ascended Mt. Cook, the loftiest peak of the region (12,349 feet). Dr. Lendenfeldt followed next year, and ascended Hochstetter Dome (9,258 feet). Since that year many ascents have been made by G. E. Mannering, Dixon, Johnson, Inglis, Brodrick and A. P. Harper, the contributor of a notice to the Royal Geographical Society. From the account and accompanying map it may be gathered that there is a great difference between the conditions, character and scenery of the eastern and western parts of the range. The glaciers of the east slope descend gradually from elevations of 5,300 to 8,600 feet to their terminations, 2,354 to 2,882 feet above the sea; the comparatively flat surface of their ice is hummocky, and for about a quarter of the length of the glaciers is covered with a considerable quantity of rough moraine; the old lateral moraines of these eastern glaciers are also distinct, especially that of the Hooker glacier, where in one part there are no less than five. On the Mackenzie plains terminal and lateral moraines have been followed for forty miles. The glaciers of the east slope have been tolerably well explored; the principal ice sheets are Tasman, 18 miles long, 1.25 to 2.14 wide, and covering 13,664 acres; Murchison, 5,800 acres, and eleven miles in length; Müller, 3,200 acres, and eight miles in length; and Hooker, 2416 acres, and seven and a quarter miles long. North of these lie the Classen glacier of 1,707 acres, 4.70 miles long, and Godley glacier, covering 5,312 acres, extending over eight lineal miles. The Aletsch glacier of Switzerland is fifteen miles by about a mile, and thus is inferior in dimensions to the Tasman glacier.

The western slopes have not yet been thoroughly explored, but it is known that they are subject to a very large rainfall, amounting to about 120 inches against 25 or 30 on the eastern slope. Though Mt. Cook is nearer to the equator than Switzerland, the glaciers descend some 3,000 feet lower than in that country. The Fox glacier, indeed, on the western slope, descends to 700 feet, and one or two others to less than 1,300 feet. These western glaciers are steep ice-falls to a short distance from their terminations, and their surfaces are almost free from moraine stuff—in consequence of the steep dip and smooth surface presented by the rock strata on this face, as compared with the jagged edges on the east slope. The lower parts of the Fox glacier, and of some others on the west, is overhung by tree-ferns and bushes growing almost on the moraine, and near to the terminal face of the Fox issues a hot spring with a temperature of 100°. A phenomenon of the same kind, on a larger scale, occurs at Mount Ruapehu (9,100 feet) in the northern island. This mountain is covered with snow and ice to the summit, where is situated a boiling lake, into which the ice melts.

These glaciers seem on the whole to be receding, especially those at the head of the Rangitata River, but last year the Müller advanced so as to dam up the Hooker River, and the Ball glacier is certainly advancing. The daily rate of flow varies; on the Ball it is from ten to eighteen inches, on the Murchison from 2.6 to 8, on the Hooker very slight, on the Müller from 3 to 12.

In 1890 Mannering and Dixon discovered that the loftiest peak, Mt. Cook, was not situated on the main range, but on its eastern side, so that it sends no water to the west coast. The next most lofty peaks are Dampier (11,823), Tasman (11,475), and a peak which bears no title on the map, though it reaches the altitude of 11,844 feet. There are several other summits that attain above ten thousand feet. The writer states that he has not seen vegetation at above 6,200 feet, and that 6,500 may be considered the highest limit. The flora is not so varied as that of the Swiss Alps.

Europe.—THE CAUCASUS.—The Caucasus still continues to be a favorite region for Alpine exploration by English and other clubs. Mr. D. W. Freshfield, himself an ardent climber, from time to time contributes a note to the Royal Geographical Society. In one of these it is mentioned that new maps show in the central Caucasus one peak over 15,000 feet, nine over 14,000, and five others over 13,000, also that in Suanetia four elevations of more than sixteen thousand feet are known, two over 15,900, three more over 15,000, and three over 14,000.

The Ossete villages, built upon summits, are stated to abound in interesting antiquities.

THE BLACK SEA.—A hydrographical exploration of the Black Sea, recently conducted by the Russian Government, has proved that the waters of that large area exist under anomalous conditions. The 100 fathom line follows the coast outline closely save in the north-west where it crosses with a slight northern inflexion, from Varna to the Crimea. From this the bottom descends at the tolerably steep gradient of twelve degrees to a depth of 800 fathoms, and from thence with a slighter inclination to 1,200 fathoms. The 1,200 fathom line encloses an oval in the center, with 1,219 to 1,227 fathoms as its greatest depths.

The upper stratum of twenty-five fathoms changes in temperature with the seasons; between this and 100 fathoms the coldest water, as low as 44° is found, while below 100 fathoms the constant temperature is 48°. In August the upper surface of the cold layer sinks to from thirty-five to fifty fathoms. The vertical circulation of the water is limited to the upper one hundred fathoms, and there is no trace of organic life below this level. The lower layers contain much sulphuretted hydrogen, besides sulphates of alkaline and earthy metals, yet the principal reason of the absence of life is probably the deficiency of oxygen in a dissolved state. The bottom from ten or twenty to a hundred fathoms is covered with a light gray mud; from 100 to 800 fathoms the mud is dark gray, and at greater depths it assumes a bluish tint through the prevalence of carbonate of lime. Remains of brackish water mussels, of which species some still live in the Caspian, while others inhabit the rivers flowing into the Black Sea, are found at depths of from one to six hundred fathoms. It has been assumed that at the beginning of the Quaternary and end of the Pliocene periods, the Black Sea was a brackish lake, without any communication with the Mediterranean, and that at the end of the glacial period the very salt waters of the Mediterranean bursting in through the newly opened Bosphorus, accumulated at the bottom, prevented circulation, and annihilated the brackish water fauna.

THE MEDITERRANEAN.—The depths of the eastern Mediterranean have been explored by the Austrian expedition in the *Pola*. A depth of 4,400 metres was found in 35° 44′ 20″ N., and 21° 44′ 50″ E. long., at a distance of only about fifty knots from Cape Matapan. A few miles farther eastward 4,080 metres was found—these are the greatest known depths in the Mediterranean. Between Candia and Alexandria 3,310 metres was found twenty miles south-east of Grandes Bay, and this depth gradually diminished to the east, to 2,120 metres near Alexandria.

The Polar Regions.—DR. NANSEN'S VOYAGE.—The opening article of the Geographical Journal for this month is a reprint of the address read before the Royal Geographical Society on November 14, 1892, by Dr. Fridtjof Nansen, the adventurous traverser of Greenland, and the daring aspirant to the honor of reaching the North Pole by drifting with the currents.

Of the existence of these currents ample proofs were adduced in the course of Dr. Nansen's speech, but of their sufficiency, their regularity, as well as of the character of the region to be traversed, whether largely open ocean, or whether cut up into intricate channels by a maze of islands, the bold argonaut could not say anything convincing.

As proofs of the general course of the currents, Dr. Nansen stated that ships turned back by floe ice drifting southward were carried between Greenland and Spitzbergen, through which passage he estimated that in every twenty-four hours a startlingly enormous quantity of water passed southward; also that other southward currents ran through Smith, Jones and Lancaster Sounds; and that undoubted relics of the unfortunate Jeannette were picked from a floe at Julianehaab three years after she sank near the New Siberian Islands. He believes the regions around the pole to act like an enormous pump, sucking in the water from Bering's Strait and East Siberia, and returning it by the Greenland Seas. Among other facts, he mentioned that several years ago, a throwing-stick of a peculiar form used only by the natives of Port Clarence, Norton Sound, Alaska, was found near Goathaab on the west coast of Greenland, also that the driftwood which reaches every year the shores of Greenland and Spitzbergen, is the timber of American and Siberian species. At the New Siberian Islands the ice is thin, while on the east coast of Greenland it is thick, and the speaker maintained that it grew in bulk as it drifted across the pole.

Specimens of mud, collected by Nansen from floes between Iceland and Greenland, had been examined by Dr. Tornebohm, of Stockholm, who had come to the conclusion that it consisted of mud from the great Siberian rivers. Dr. Cleve, of Upsala, had also examined the dust from the snow of these floes, and had identified sixteen species of diatoms, all of which were known to be found at Cape Wankarena, near Behring Strait, and twelve of which were only known from there. The pumice abundantly strewn on some parts of the shores of Norway, Spitzbergen and Greenland, is stated by Bäckström to be andesitic, and must therefore have been derived from some andesitic volcano near Bering Sea—this proves a post glacial communication. A great deal of this pumice is now, probably on account of the rising of the land, at from thirty to seventy feet above sea-level.

In order to guard, as far as possible, against the danger of being crushed in the solid ice, a ship of small size and great strength, yclept the *Fram*, has already been built. She displaces about 600 tons, is large enough to accommodate twelve men with food and fuel for five or six years, and has engines of 160 horse power, enabling her to steam some six knots hourly. The sides slope from bulwarks to keel, so that the pressure of the ice may tend to lift her out of the water (as occurred in the case of the *Tegethoff*); she is broad in proportion to width, pointed at both ends, flat-bottomed near the keel, which is almost covered by the boarding, and has a considerably curved stem. A special point is the arrangement for raising the screw clear out of the water —two reserve screws are to be carried. The sides are planked with pitch-pine, oak, and greenheart to a total thickness of over twenty-eight inches. The length at water-line is 113 feet, and the sailing speed is reckoned at from 8 to 9 knots. The *Fram*, or Forward, was launched at Laurvik, October 28, 1892, and will start on her hazardous cruise in the Spring. She has ten boats of various kinds, including two specially large and strong, intended for the homeward voyage in case the ship should be crushed; a dynamo will also be taken.

The reading of this paper was followed by a long discussion, in which various objections were brought forward by distinguished Arctic navigators. Some of these were successfully answered by Dr. Nansen, who, however, seemed inclined to follow the advice of Captain Wiggins, and to start by way of the Kara Sea, rather than from the New Siberian Islands. Sir George Nares pointed out the danger of disregarding the usual maxim to keep close to shore, and said that several years would be required for the drifting, during the whole of which time the vessel would be in danger. A vessel frozen-in became a solid block with the ice. He accepted the homing current as proven, but doubted the existence of the out-going one, or at least its power to overcome the force of the winds. The largest fresh-water rivers lost all influence at a distance of 200 miles from their mouth. The *Fram*, he said, could not at best expect to reach more than sixty miles north of 76° 30′ before meeting with the ice-pack, and would thus be frozen-in 730 miles from the Pole and 600 from the home current. He believed that the wind would be more likely to drift the vessel to the west than to the east.

Sir A. Young said that the greatest danger arose from the land. The remains of the Jeannette had probably found their way through narrow channels, in the course of years. He considered the fact that a tame reindeer had once found its way from Siberia to Upernavik, in Greenland, proved the existence of land. The advice of Captain Wiggins was not to wait for a squeeze, but to endeavor to run the vessel on to the top of the ice.

To all these Dr. Nansen answered by a declaration that, as he had abandoned his ships to cross Greenland, so he meant to abandon the coast to reach the Pole; he believed that the winds acted with and caused the currents.

Admiral Sir G. H. Richards, in a written communication states his belief that the enormous ice-cap of the pole, and the weight of snow, cause an outflow in all directions. Solid ice north of 78° is his conception of the Arctic.

Finally Sir J. D. Hooker writes a word of earnest warning. The lines of a ship may be of use in an open pack, but not when forced against land, amongst floes and bergs, or when the vessel is on her beam ends. He then enlarges upon the depressed spirits produced by the long confinement in close quarters, ever in prey to a haunting uncertainty, to say nothing of the risk of scurvy.

General Notes—The Geographical Journal, the first number of which appeared in January, can scarcely be called a new magazine, since it is but the well-known "Proceedings of the Royal Geographical Society" in a new dress, a dress which will, it is hoped, tend to popularize the study of Geography, and thus gain for itself a wider circle of subscribers than was reached by the "Proceedings." One of the most noticeable new features is the more extended reviews of recently issued books, printed in the same type with the principal articles.

Before the outbreak of the war with Chili, a Geographical Society had been founded at Lima, by D. Manuel Pardo. This was broken up by the war, but was again started on April 15th, 1891. The first volume of the "Proceedings" contains much of interest; among other things an article on the phenomenon known as the "Callao Painter," by S. Raimondi, and others on the River Purus, the geology of Huanta, and on the subsidence of Lake Titicaca. The president is

D. Louis Carranza, a physician and a close observer, the secretary of the philologist, G. P. Zegarra.

Among well-known geographers who have passed away during 1892 may be mentioned Bates, the "Naturalist on the Amazon"; Grant, Speke's companion to the sources of the Nile; Lord Arthur Russell, Professor Moseley, and Sir Lewis Pelly, who, while stationed at Bushire, adventurously penetrated in British uniform to the stronghold of the fanatical Wahabis. This was in 1865. At Riyadh he met the blind Saiyid Amir, and was allowed, in appearance, to depart in safety, but on their homeward march the party found that their water-bottles had been poisoned, and suffered agonies of thirst, the only refreshment they could gain being to pour the water over their wrists.

In an address delivered before the Berlin Geographical Society, Professor J. Walther compares the desert regions of America with those of Africa, and finds the similarity greater than is generally supposed. Both are characterized by four distinct types of denudation, gravel beds, sand-dunes, loam regions and salt deposits. In both the mountains rise out of the plains like so many islands, without any intervening debris, and in both the "amphitheatre" formation is common. Both exhibit the denudating powers of heat and dryness, the first splitting the rocks into fragments, while the dry winds whirl the dust into heaps. No doubt water, even here, is the chief agent, but it has not more than sixty days in which to accomplish its work. The chief difference between the American arid lands and those of North Africa is the steppe vegetation of the former.

GEOLOGY AND PALEONTOLOGY.

Geology of Eastern Siberia.—The *Investia* of the East Siberian Geographical Society (Vol. xxiii, 3) contains an account of M. Obrutcheff's further researches in the Olekma and Vitim highlands. In the northeastern part of this region the author found a further continuation of the "Patom plateau"—that is, a swelling from 3500 to 4000 ft. high, devoid of trees, with ridges and mountains rising over it to heights of from 5000 to 5600 feet. They consist of granite and crystalline schists, probably of Laurentian age, covered with younger, probably Huronian, gneisses and schists. The other parts of the highlands consist of Cambrian and Ordovician deposits, while Silurian limestones and Devonian Red sandstones are met with in the Valley of the Lena. We thus have a further confirmation of the hypothesis, according to which the great plateau of northeastern Asia is a remnant of an old continent which has not been submerged since the Devonian epoch. Further traces of mighty glaciation have been found in the southeastern part of the region. As to the gold-bearing deposits, they are pre-glacial in the south and post-glacial in the north. The high terraces in the valleys are indicative of a considerable post-pliocene accumulation of alluvial deposits, and of a subsequent denudation on a large scale. (Nature, Jan. 12, 1893).

Geological Features of Arabia Petræa and Palestine.—At a recent meeting of the London Geological Society, the following communication was read by Professor Edward Hull on the Geology of Arabia Petræa and Palestine:

The most ancient rocks (Archean) are found in the southern portion of the region; they consist of gneissose and schistose masses and are penetrated by numerous intrusive igneous rocks. They are succeeded by the Lower Carboniferous beds of the Sinaitic peninsula and Moabite tableland consisting of bluish limestone with fossils, which have their counterparts chiefly in the Carboniferous limestone of Belgium, and of a purple and reddish sandstone (called by the author "the Desert Sandstone," to distinguish it from the Nubian Sandstone of Cretaceous age), lying below the limestone. The Nubian Sandstone, separated from the Carboniferous by an enormous hiatus in the succession of the formations, is probably of Neocomian or Cenomanian age, and is succeeded by white and gray marls, and limestones with flint, with fossils of Huronian and Devonian ages. The Middle Eocene (Nummulitic Limestone) beds appear to follow on those of Cretaceous age without a discordance, but there is a real hiatus notwithstanding the apparent conformity, as shown by the complete change of fauna. In Philistia a calcareous sandstone in which no fossils have been discovered is referred to the Upper Eocene; for the Miocene period was a continental one, when faulting and sliding were taking place, and the main physical features were developed—e. g., the formation of the Jordan-Arabah depression is referable to this period.

In Pliocene times a general depression of land took place to about 200–300 feet below the present sea-level, and littoral deposits were formed on the coasts and in the valleys. To this period belong the higher terraces of the Jordan-Arabah valley. The Pliocene deposits consist of shelly gravels. Later terraces were formed at the epoch of the glaciation of the Lebanon Mountains, when the rainfall was excessive in Palestine and Arabia.

The volcanoes of the Jaulân, Hauran, and Arabian Desert are considered to have been in active operation during the Miocene, Pliocene, and Plistocene periods, but the date of their final extinction has not been satisfactorily determined. (Geol. Mag., Jan., 1893).

The Vertebrate Fauna of the Ordovician of Colorado.—Mr. Charles D. Walcott has recently published a paper on the vertebrate fauna in strata of Ordovician age near Canyon City, Colorado, already noticed in THE NATURALIST. The fossils consist of what appear to be the plates and scales of fishes and the ossified chordal sheath of a fish allied to the recent Chimæra. The remains occur in a sandstone which is correlated with the lower Trenton and the lower Bala of Wales. Microscopic sections of a dermal plate belonging to an *Asterolepis*-like form, examined by Dr. Otto Jaekel, show (1) the dentine tubules that are characteristic of vertebrates; (2) the occurrence of true osteoblasts, which exclude the forms from the Elasmobranchii, and relegates them to other low divisions of the fishes; (3) the absence of enamel and the distinct concentric lamination of the dentine tubules which indicate a low stage of development.

In view of the objections that can be made to a classification based entirely upon the characters of the dermal plates and scales Mr. Walcott has made his classification tentative and has only outlined the characters of the fragmentary remains. For the present, then, the fossils will be known respectively as *Dictyorhabdus priscus*, a supposed chimaeroid, and *Astraspis desideratum* and *Eriptychus americanus*, rhipidopterygians. It is, however, extremely unlikely that these forms are fishes, but they are more likely Agnatha.—Bull. Geol. Soc. Am., Vol. 3, pp. 153–172. C.

The Loess in Southern Russia.—In his notes on Russian Geology Mr. W. F. Hume gives an interesting account of the Russian Loess, its character and distribution, together with a theory of its origin.

The Russian Loess is a yellowish-brown sandy clay, often rich in grains of quartz and mica, and in many places rich in carbonate of lime and humus. In lies unconformably on all the principal formations. To the west of the Dnieper it conceals the broken and contorted gneisses and granites of the Archean axis in S. Ekaterinoslav and the Don Cossack country it covers the shales and sandstones of the Carboniferous, whilst in the more central governments of Kursk, Karkoff, and Tchernigov it overlies the Cretaceous and the whole Tertiary series. Also along a definite line running to the north of these governments it rests upon the Boulder-clays and sands of the Glacial period. From its general appearance Mr. Hume considers the Loess of Russia to be more or less coeval with that of Central and Western Europe, and the paleontological evidence seems to confirm his view.

In discussing the origin of the Loess Mr. Hume calls attention to the relation, pointed out by Professor Suess between the Loess and the Glacial Drift, and gives in detail the theories of Professor Armachevsky and Baron von Richthofen, neither of which is sufficient in itself to account for the distribution of the Loess.

In conclusion the author gives the following statement of the probacle sequence of events:

I. The Loess particles may be originally derived from the finely ground material resulting from the wearing of the subjacent beds by the ice-sheet.

II. The same have been deposited in tundra-like depressions under the influence of slowly moving waters or by the action of rivers in flood.

III. This deposit under more temperate conditions dried up, and was then suitable material for the redistributive action of the wind.—(Geol. Mag., Dec., 1892).

Sources of the Texas Drift.—Mr. Dumble divides the Texas drift area into four districts. First the Trans-Pecos Texas, the valley of the Rio Grande, and the Rio Grande Divide. The origin of this drift is traceable to the mountainous region of Trans-Pecos Texas, where nearly every variety of pebble can be found in its original location. Second, the country between the Nueces and the Brazos. This region is covered with pebbles, gravel and sand derived from the rocks found in the Central mineral region. Third, from the Brazos to the Sabine, where the gravel is largely made up of ferruginous material which had its origin in the iron-capped hills which cover so large a portion of Eastern Texas. Fourth, the area known as Northwest Texas according to the survey division. The drift of this region came from the hills enclosing the waters under which they were deposited, viz., Wichita Mountains and the mountains of New Mexico.—Trans. Texas Acad. Sci., Vol. i, 1892.

Archean.—According to Mr. H. V. Winchell, Minnesota possesses the greatest iron district known in the world to-day. It lies in the Mesabi range and extends from the Canadian boundary line in a direction a little south of west, beyond the Mississippi River, a distance of 140 miles. The ore on the eastern end is hard, black and magnetite, owing to the heat of the gabbro overflow. In the central and western portions of the range the ore is soft hematite, limonite and geothite. As to the source of the iron, it is believed by Mr. Winchell to be largely the result of oceanic deposition, both chemical and mechanical, and to have been concentrated in its present situations. (Twentieth Ann. Rept. Minn. Geol. Surv., 1892).—Mr. T. R. Struthers advances the theory that the primitive rocks, *i. e.*, granite, were formed by the cooling of the exterior of the globe under the primeval deep. The pressure of the sea at the depth of two miles would be sufficient to account for the structure of granite. This theory explains the features presented by the bedded or stratified granite of the British islands and many other parts of the world. (Geol. Mag., Dec., 1892.)

Paleozoic.—A skull of *Dinichthys intermedius* recently examined by Professor E. W. Claypole supplies details previously unknown regarding the plates of which it is composed. The especial points of interest are the forms of some of the plates and the over and underlap which has not been represented, and some additions to the structure of the upper jaw. (Am. Geol., Oct., 1892.)—Mr. Herbert Bolton reports a triolobite from the Skiddaw slates of the Isle of Man. The specimen belongs to one of two genera, *Asaphus* or *Æglina,* both of which are Ordovician forms. This in connection with the occurrence of two specimens of Palæochorda (an Arenig form) is strong evidence that the Skiddaw slates are of Llandeilo age. (Geol. Mag., Jan., 1893).—A species of Cyclus from the Coal Measures of Lancashire, England, is described and figured in the Geol. Mag., Jan., 1893, by Dr. Woodward. The fossil is about as large as a shilling and resembles *C. agnotus* H. von Meyer. Mr. Woodward considers it a new species, and names it *Cyclus scottii.*

Mesozoic.—A new crustacean, *Prosopon etheridgei*, from the Cretaceous beds of Queensland is described by Dr. Henry Woodward. This crustacean is closely related to *P. verrucosum* Reuss, and *P. tuberosum*, von Meyer, two Neocomian species from the Cretaceous of Boucheraus, Dept. Jura. It differs from both, however, in several important points. (Proceeds. Linn. Soc. N. S. W., Vol. vii, 1892).—Mr. R. Etheridge reports a new fossil Phyllopod from the Upper Coal Measures of the Newcastle District, N. S. W., belonging to the genus Leaia. This is the second genus of that family known from the whole of Australia. Mr. Etheridge has named the species *Leaia mitchellii* in honor of its discoverer, Mr. Mitchell. (Proceeds. Linn. Soc. N. S. Wales, Vol. vii, 1892).

Cenozoic.—Mr. J. H. Cooke reports finding the jaw of an Arctic bear, *Ursus arctos* in pleistocene strata of Malta. The fossil, consisting of an entire ramus with its canine and molar teeth, was found in a cavern together with bones of elephants, hippopotami, a stag, and a large dog. (Knowledge, Dec. 1, 1892).—According to Baron DeGeer the Pleistocene changes of level in North America as well as in Europe, are closely connected with the local structure of the earth's crust and with the local extension of the glaciations, and that these changes cannot be accounted for by changes in the level of the sea. (Amer. Geol., Jan., 1893).—M. Bureau has described two fossil plants from the Calcaire *grossier parisien.* The first, called by the author *Aralia eocenica,* is represented by an impression of a leaf remarkable for the slender, long petiole. The second, *Monochoria parisiensis,* resembles strongly certain species of living Monochoria found in India, Ceylon, Malay, China and Japan. (Revue Scientifique, Jan., 1893).

MINERALOGY AND PETROGRAPHY.[1]

The Rocks of the Thalhorn.—In the Thalhorn of the Upper Amariner Thal are found a porphyritic granite, between conglomerates composed of gabbro pebbles in a schistose matrix, and also serpentines, massive gabbro, schists, and various contact rocks. Linck[2] gives a good petrographical description of all these, and geological notes of their occurrence. The main granite mass is a portion of the well-known Kamm granite. It is found in dykes and flows, and it varies in its composition and structure from a typical granitite containing two feldspars, through porphyritic granite and syenite to lamprophyric minettes. The unaltered sediments near the eruptive are graywackes. On the contact with the granite the clastics are altered to knotty schists that are predominantly biotite schists flecked with light spots, consisting mainly of quartz and feldspar in micropegmatitic intergrowths, surrounded by biotite. Extreme alteration gives rise to hornstones, of which the writer recognizes several varieties. In these biotite, feldspar, hornblende and micropegmatite are so orientated as to resemble the poicilitic structure of many diabases and other basic rocks. Hornblende is abundant in them as needles scattered through the groundmass and as large phenocrysts. The conglomerates occupy the greater share of the writer's attention. In one group acid pebbles occur in a sandy or clayey matrix of basic detritus, in which biotite, feldspar and hornblende are new products of alteration. A second group includes rocks made up partly of gabbro material. Here the author again recognizes two groups, in one of which diallage and other gabbro constituents are occasionally present in the groundmass, and a second in which gabbro material forms a very large portion, either of the matrix or of the pebbly portion of the rock. In either case the rock is much altered, with the resulting formation of plagioclase and hornblende. The serpentine of the region was originally an olivine-enstatite rock and not a gabbro as has been supposed.

The New Jersey Eleolite-Syenite.—The New Jersey Eleolite-syenite dyke described by Emerson[3] is again studied by Kemp,[4] who declares that the earlier description applies only to that phase of the rock occurring in the northern and the southern portions of its extent. The pyroxene throughout the dyke is aegerine. Cancrinite and sodalite are both fairly abundant in it. An analysis of specimens collected from about the point visited by Emerson gave:

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Mitth. d. geol. Landesanst v. Elsass-Loth., iv, 1892.

[3] Amer. Jour. Science, iii, xxiii, p. 302.

[4] Trans. N. Y. Acad. Sci., Vol. xi, p. 60.

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	Loss	Total
50.36	19.34	6.94	.41	3.43	not det.	7.17	7.64	3.51=	98.80

Eleolite porphyries with a tinguaitic groundmass are closely associated with the more abundant syenite, and along the eastern side of the great dyke are smaller ones of ouachitite and fourchite. The basic material of these small dykes, when first[5] studied, was regarded as porphyrite. Contact effects produced by the intrusion of the syenite through the surrounding shales are noticed on the east side of the dyke, where the sedimentaries have been changed to biotitic hornfels.

Mica Peridotite from Kentucky.—A mica peridotite[6] from a dyke in Crittenden Co., Ky., is composed essentially of biotite, serpentine, and perofskite, with smaller proportions of apatite, muscovite, magnetite, chlorite, calcite, and other secondary products. The biotite and serpentine constitute about 75% of the entire rock. The mica is in large plates in which are scattered the grains and shreds of serpentine. The composition of the rock follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	CO_2
33.84	3.78	5.88	7.04	5.16	9.46	22.96	2.04	.33	7.50	.89	.43

and small quantities of Cr_2O_3, MnO, NiO, CoO, BaO and Cl. The rock represents a new type of peridotite in which biotite takes the part of an amphiboloid in the more usual types.

Rhyolites in Maryland and Penn.—G. H. Williams[7] has identified an extensive series of old volcanic rocks in the South Mountain region of Pennsylvania and Maryland. The rocks have hitherto been considered sedimentaries, but to the writer they exhibit all the peculiarities of eruptives, though some of the beds are fragmental tufas and breccias. The two principal types are rhyolite and basalt. The former possesses all the features of recent eruptives, such as flowage

[5] Amer. Jour. Sci., III, xxxviii, p. 130.

[6] J. S. Diller, Amer. Jour. Sci., xliv, 1892, p. 286.

[7] Ib., xliv, 1892, p. 482.

lines, spherulites, lithophysae and amygdaloidal cavities. Quartz and an alkaline feldspar are the prevailing phenocrysts, while the groundmass is a quartz-feldspar mosaic. The basalts are much altered, but their structure is clearly that of an eruptive. A detailed account of the rocks is promised later.

The Nepheline and Leucite Rocks of Brazil.—A more careful study of a few of the Brazilian nepheline and leucite rocks undertaken by Hussak[8] has resulted in the discovery of leucite in some of the phonolites, and in the detection of leucite-tephrites containing pseudo-crystals. The leucitophyres consist of phenocrysts of sanidine, augite, nepheline and pseudo-leucites in a groundmass of small zeolitized leucites, augite, magnetite and nepheline. The leucite-tephrites are all characterized by the possession of the pseudo-leucites. In many cases these are nothing but spherical masses of the rock material surrounded by biotite plates. In other cases the biotite surrounds analcite or mixtures of analcite and calcite. The structure of several of these rocks is the diabasic. With these the author would place a rock described by Eigel[9] from the Cape Verde Islands, and the augite-porphyrite described by Kemp[10] from Deckertown, N. J., in both of which traces of leucite are thought to have been discovered. Hussak has also found a leucitite dyke in phonolite near Poços de Caldas, and a leucitite tufa composed of fragments of basalt, isolated crystals of leucite changed to analcite, pieces of augite and crystals of magnetite. The author concludes his paper with remarks on 'pseudo-crystals' combating the view of Derby that they are true leucite crystals filled with inclusions of the rock's groundmass.

The last named writer[11] has examined the Peak of Tingua with some care, finding eleolite-syenite, phonolite and dykes of basic rocks. The syenite and phonolite are thought to be phases of the same magma, as they apparently grade into one another. The phonolitic phase occurs both in dykes and in flows associated with phonolite tufas. The origin of the pseudo-crystals is discussed briefly.

Petrographical News.—Brauns[12] has discovered hauyne in the pumice sandstone near Marburg, a mineral hitherto unobserved in the rock because of the loss of its characteristic blue color through alteration. The list of minerals common to this rock and to those of the Laacher See is now complete, so that the belief in a common origin for them is rendered almost a certainty.

---

[8] Neues. Jahrb. f. Min., etc., 1892, II, p. 141.

[9] AMERICAN NATURALST, Feb., 1892, p. 165.

[10] See above under 'The New Jersey Eleolite-Syenite.'

[11] Quart. Jour. Geol. Soc., May, 1891, p. 251.

[12] Zeits. d. deutsch. geol. Gesell., xliv, 1892, p. 149.

C. W. Hall[13] gives a few notes on rocks collected from Central Wisconsin, describing very briefly hypersthene and quartz gabbros in which there is much secondary hornblende, and quartz diorites and gneisses regarded as squeezed gabbros.

A fourchite boulder in which are large arfvedsonite phenocrysts is mentioned by Kemp[14] as occurring at Aurora, Cayuga Co., N. Y. The same author mentions the existence of rhyolite, hypersthene, andesite and andalusite-hornstone from near Gold Hill, Toole Co., Utah.

Spherulites[15] of andalusite occur in the carboniferous clastic schists of Beaujeu, France. The schists are composed of black and white mica fragments in a paste of sericite and hematite.

Turner[16] makes brief mention of basaltic, andesitic and rhyolitic lavas, whose source was the late Tertiary cone Mt. Ingalls, in California.

Crystallographic Study of Diopsides.—Some very careful crystallographic observations have been made by A. Schmidt[17] upon the diopsides of the Alathal, of Achmatowsk, of Nordmark, of the Zillerthal and the Arany-Berg. Many crystals from each of these famous localities were examined, and much new data was obtained concerning the mineral. The following new planes were discovered: $4P\bar{2}$ and $5P\frac{5}{3}$ on the white diopside from Achmatowsk; $\frac{11}{3}P\grave{\infty}$ on the green variety from the same place; $\infty P6^{\backprime}$ in the Nordmark species; $\infty P\overline{10}$, $\infty P4^{\backprime}$ and $\infty P\frac{7}{3}$ on the nearly colorless small crystals from Schwarzenstein in the Zillerthal, and $\infty P\bar{7}$ and $P\bar{4}$ on the black Arany-Berg mineral. The form $P\bar{4}$ appears in Goldschmidt's 'Index,' but no reference to it could be found by the author in the original memoirs. The axial ratios of the different varieties are:

Alathal..................................	1.0895 : 1 : .5894	$\beta = 74°15'47''$
Achmatowsk (white)..................	1.0909 : 1 : .5899	$\beta = 74°10'42''$
Achmatowsk (green)..................	1.0951 : 1 : .5985	$\beta = 73°31'8''$

---

[13] Minn. Ac. Nat. Science, III, No. 2, p. 251.

[14] Trans. N. Y. Acad. Sci., xi, p. 92.

[15] Lévy. Bull. Soc. Franç d. Min., xv, 1892, p. 121.

[16] Amer. Jour. Sci., Dec., 1892, p. 455.

[17] Zeits. f. Kryst., xxi, 1892, p. 1.

Nordmark..................................	1.0915 : 1 : .5848	$\beta = 74°38'59''$
Zillerthal (colorless).....................	1.0922 : 1 : .5887	$\beta = 74°16'28''$
Arany-Berg (yellow)......................	1.0945 : 1 : .5918	$\beta = 74°19'38''$
Arany-Berg (black).........................	1.0913 : 1 : .5875	$\beta = 74° 4'53''$

The optical angle for the Nordmark crystals is 2Vna = 60°44′, and $C \wedge c = 45°21'$. For the dark Zillerthal diopside 2Vna = 58°56′ and $C \wedge c = 34°4'$.

Herderite from Hebron, Maine.—A single specimen of Herderite from Hebron, Maine, is described by Wells and Penfield[18] as a few yellowish white crystals on albite. The crystals have a tabular habit, with oP, ∞ P, 3P and $\frac{3}{2}$P the only forms observed. The density is 2.975 and composition :

P_2O_5	BeO	CaO (by diff.)	H_2O	F	Insol.	Total
40.81	15.32	32.54	5.83	.40	5.27	= 100.17

Corresponding to Ca Be (OH) PO_4, or a herderite in which nearly all of the fluorine is replaced by hydroxyl.

Mineralogical Notes—A *calcium carbonate* of secondary origin from the Marble Mountains of Wolmsdorf in Glatz has been analyzed by Kosmann[19] with the following astounding result: $CaCO_3 = 4.32$; chemically combined $H_2O = 1.54$; mechanically combined $H_2O = 94.13$. The author believes the mineral to be a hydrated carbonate $CaCO_3 + 2H_2O$ capable of absorbing a large quantity of water, similar to the 'Mountain Milk' of Rose.

The *friedelite* of the Manganese mine of Sjogrube, Orebro, Sweden, occurs in large quantity in clefts, veins, etc., that are partially filled with calcite. An analysis yielded Igelström:[20]

SiO_2	Cl	MnO	FeO	CaO	MgO	NaO	H_2O	Total
34.36	3.00	45.88	1.35	1.50	1.50	2.79	9.00	= 99.38

On the *Azurite* from the Laurion Mts., Greece, Zimanyi[21] has found 28 forms, three of which ($\frac{2}{3}P\overline{\infty}$, $\frac{4}{3}P\breve{\infty}$ and $\frac{8}{3}P\overline{\infty}$) are new. The crystals have the usual habit of the mineral, and they compare favorably in beauty with those from Chessy, Arizona and Utah.

---

[18] Amer. Jour. Sci., xliv, 1892, p. 114.

[19] Zeits. d. deutsch. geol. Ges., xliv, 1892, p. 155.

[20] Zeits. f. Kryst., xxi, p. 92.

[21] Ib., xxi, p. 86.

Tremolite[22] pseudomorphs after sahlite from the limestone of Canaan, Ct., have the composition:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
60.98	.10	.12	.19	14.64	23.62	.13	.21

The controversy over the nature of *Melanophlogite* is not yet ended. Bombicci[23] has recently defended himself against the attack of Friedel, and in his defense he accuses his opponent with misquoting him.

New Minerals.—*Ganophyllite,* from Harstige, near Pajsberg, Sweden, is a manganese zeolite[24] that is associated with barite, lead, and rhodonite. It occurs in large brown monoclinic, prismatic crystals, in which ∞P is combined with the base and the clinodome. $a : b : c = .413 : 1 : 1.831$. $\beta = 86°39'$. On cleavage plates parallel to oP a percussion figure may be produced, one of whose rays is parallel to a and the other two inclined at 60° to this. Plane of optical axes is perpendicular to $\infty \breve{P} \infty$, with c the first bisectrix. $2E$ (air) $= 41°53'$ for sodium light, and $2V = 23°52'$. The pleochroism is strong $c = A$ = yellow-brown; $a = B$ and $b = C$ = colorless. The density is 2.84 and hardness = 4. A mean of two analyses gave Hamberg a result that may be represented by $8SiO_2\,Al_2O_3\,7MnO + 6H_2O$.'

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	PbO(?)	K_2O	Na_2O	H_2O	Total
39.67	7.95	.90	35.15	1.11	.20	.20	2.70	2.18	9.79	= 99.85

Pyrophanite, described by the same author as occurring in the same mine, is a manganese titanium compound isomorphous with ilmenite. An analysis gave:

SiO_2	TiO_2	MnO	Fe_2O_3	Sb_2O_3	Total
1.58	50.49	46.92	1.16	.48	= 100.63

It is found as brilliant, deep red, transparent tables, associated with ganophyllite. $a : c = 1 : 1.369$. The double refraction is strong, and the indices of refraction for sodium light are $\omega = 2.481$, $\epsilon = 2.21$. Density is 4.537.

Synthesis of the Members of the Sodalite Group.—The minerals of the sodalite group have been manufactured by Moroziewics[25] as microscopic crystals. A mixture of 65 parts $SiO_2 + 3Aq$, 44 parts $Al_2O_3 + 3Aq$, and 33 parts gypsum, heated in a platinum crucible with an excess of Glauber's salt, yielded tiny cubes and dodecahedra of hauyne or sodalite. When heated with an excess of $Na_2SO_4 + NaCl$ a substance was obtained that is supposed to be an isomorphous mixture of the two minerals above mentioned, and in addition some sodalite crystals were produced. When heated with Na Cl alone sodalite only resulted.

---

[22] W. H. Hobbs. Amer. Geol., July, 1892, p. 44.

[23] Bull. d. l. Soc. Franç d. Min., xv, p. 144.

[24] Ref. Neues. Jahrb. f. Min., etc., 1892, II, p. 234.

Methods and Instruments.—A simple method for determining the value of the optical angle in thin sections of minerals is described by Lane.[26] It consists essentially of the measurement of the angular distance between the hyperbolas of the biaxial interference figure by means of the sub-stage mirror.

A cheap form of crystal refractometer constructed on the same principles as the larger Zeiss instrument has been made by Czapske.[27] The height of the complete instrument is only 25 cm. It is suitable for all ordinary refraction work.

An Appendix to the "Gems of North America."—Mr. Kunz has issued an appendix to his valuable 'Gems and Precious Stones of North America'[28] that brings the volume up to date. Most of the material in the appended chapter has appeared in the journals, but some of the information it contains is new. The author states that the sapphire gravels of Ruby Bar, Montana, and the turquoise mines of New Mexico are now being worked by companies that expect their outlay of capital justified by a goodly yield of gem material. The turquoise company has already taken from their diggings about a hundred thousand dollars worth of gems.

[25] Neues. Jahrb. f. Min., etc., 1892, II, p. 139.

[26] Science, Dec. 23, 1892, p. 354.

[27] Neues. Jahrb. f. Min., etc., 1892, I, p. 209.

[28] Cf., AMER. NATURALIST, Dec., 1891, p. 1119.

BOTANY.

An International Botanical Congress.—After careful consideration of all the conditions it has been thought advisable to take steps toward securing an International Congress of Botanists in connection with the meeting of the American Association for the Advancement of Science in Madison next August. Upon the return of Professor Underwood from Genoa with his report of what was done there, as well as of what was left undone, such a Congress seemed a necessity, especially when it was learned that the delegates to the Genoa Congress expected one to be held in America this year in order to complete the work left by them. Moreover, the Columbian Exposition will doubtless bring many foreign botanists to this country during the year, and most of these will attend our scientific meetings whenever it is possible to do so. It seems wise, therefore, to take advantage of these favorable conditions and to arrange for a formal Congress.

After a good deal of consultation on the part of those who could more readily do so, it was suggested that the Chairman of the Section of Botany of the American Association for the Advancement of Science and the President of the Botanical Club (Dr. Wilson) should appoint a committee to take the matter in hand. In accordance with this suggestion notices were sent on Dec. 9 to the following gentlemen with the request that they serve on such committee: J. C. Arthur, L. H. Bailey, N. L. Britton, D. H. Campbell, J. M. Coulter, B. T. Galloway, Conway MacMillan, B. L. Robinson, William Trelease, L. M. Underwood, George Vasey.

It is to be hoped that the heartiest support will be given to the committee in their effort to bring to a successful issue the purpose for which they were appointed.—CHARLES E. BESSEY, *Chairman of Section G (Botany), A. A. A. S.*

Botanical Notes.—Mr. B. M. Davis, in the December number of the "Annals of Botany" describes and figures all the stages of development from the carpospore to the young growing plant of *Champia parvula*, one of the common red seaweeds of both the Atlantic and the Pacific coasts. It is a valuable contribution to the embryology of the *Florideæ*.—A. P. Morgan describes in the "Journal of the Cincinnati Society of Natural History (October) a singular new fungus of the family Phallaceæ, for which he proposes the generic name *Phallogaster*. It appears to connect the Phallaceæ with the Lycoperdaceæ; in fact it is difficult to say why it may not be placed near the Puff-Balls rather than near the Stink-Horns. The single species is *P. saccatus*. Specimens have been collected in Ohio, New York and Connecticut, showing that it is not local in its distribution.—In the "Contributions from the U. S. National Herbarium," issued in December, 1892, J. M. Holzinger publishes lists of the plants collected by C. S. Sheldon and M. A. Carlton in the Indian Territory in 1891. The novelties are, a variety (*fasciculata*) of *Solidago missouriensis;* a species of trailing morning glory (*Ipomœa carletoni*) with narrowly lanceolate leaves and large flowers (2 to 2½ inches long) which are solitary or occasionally in twos or threes; and a new Euphorbia (*E. strictior*), with very narrow leaves. Dr. Engelmann's *E. polyphylla*, the description of which has hitherto not been published, is here characterized and distinguished from *E. wrightii*, *E. strictior* and *E. discoidalis*.—In the same publication Mr. Carleton publishes some useful "Observations on the Native Plants of Oklahoma Territory and Adjacent Districts." His observations upon the native grasses are especially valuable.—Mr. B. B. Smyth, of Topeka, Kansas, has published a useful "Check-list of the Plants of Kansas," with especial reference to his proposed distribution of botanical specimens.—The Contributions to American Botany from the Herbarium of Harvard University which the writings of Gray and Watson have made familiar to botanists throughout the world, have been resumed by Dr. B. L. Robinson, the Curator of the Gray Herbarium. His latest contribution consists of Descriptions of New Plants Collected in Mexico by C. C. Pringle in 1890 and 1891, with notes upon a few other species. Among the more notable things is a new genus of Umbelliferæ to which he gives the name *Coulterophytum*, which suggests that the author has taken the hint given by Otto Kuntze in regard to the manufacture of names! *Geissolepis*, a new genus of Compositæ is represented by a single species of prostrate plants from San Luis Potosi.—Dr. Britton, in the Transactions of the N. Y. Academy of Sciences (Nov., 1892), discusses "*Ranunculus repens* and its Eastern North American Allies." He recognizes six species as follows: 1. *R. repens* L., sparingly introduced from Europe; 2. *R. macounii* Hook, Canada and in the Rocky Mountains of U. S.; 3. *R. hispidus* Michx., Ontario to Georgia and west to Michigan, Northwest Territory and apparently to Texas; 4. *R. fascicularis* Muhl., widely distributed; 5. *R. septentrionalis* Poir., eastern Canada to Minnesota, south to Pa. and Ky.; 6. *R. palmatus* Ell., South Carolina, Ga. to Fla.—In a "Preliminary List of American Species of Polygonum" in the *Torrey Bulletin* for December Mr. John K. Small enumerates seventy-nine species. Some changes are made in the nomenclature, and two new species (*P. mexicanum* and *P. pringlei* are described from San Luis Potosi, Mexico.)—"Amherst Trees," by Professor J. E. Humphrey, and "The Woody Plants of Manhattan in their Winter condition," by Professor A. S. Hitchcock, are two pamphlets which indicate the increasing interest in forest trees as constituents of the flora of a locality. The first named is the more popular and treats of many New England trees from the standpoint of the tree lover and the landscape gardener; the second is quite scientific, and is intended to aid the people of the plains (Kansas) to identify trees in their winter state.—A. W. Bennett has published in the "St. Thomas Hospital Reports" (London) a useful paper entitled "Vegetable Growths as Evidence of the Purity or Impurity of Water." He discusses the subject under four heads, as follows: I. Flowering Plants; II. Fungi; III. Algæ; and IV, Characeæ. The presence of the first is "a sign of comparative purity of the water;" of the second of the impurity of the water. The blue-green algæ (*Cyanophyceæ*) "should be regarded as rendering it (the water) unfit for domestic purposes." The chlorophyll-green algæ (*Chlorophyceæ*) are probably innoxious, in spite of the prevalent opinion to the contrary. The Characeæ are regarded as noxious "since when decaying they give off a strong fetid odor, accompanied by evolution of sulphuretted hydrogen gas."

ZOOLOGY.

Allen's Faunal Areas of North America.—In a paper on the Distribution of North American Mammals, Mr. J. A. Allen gives the following tabular synopsis of the faunal areas of North America:

Realms	Arctic.	
	North Temperate.	
	American Tropical.	
Regions	North American.	< North Temperate Realm.
	Central American.	< American Tropical Realm.
	Antillean.	
Subregions	Cold Temperate	=North American Region.
	Warm Temperate	
Provinces	Humid.	=Warm Temperate Region.
	Arid.	
Subprovinces	Appalachian.	=Humid Province.
	Austroriparian.	
	Campestrian.	=Arid Province.
	Sonoran.	
Districts	Great Plains.	=Campestrian Subprovince.
	Great Basin.	
	Pacific Coast.	
Faunæ	Barren Ground.	Arctic.
	Alaskan-Arctic.	
	Aleutian.	Cold Temperate.
	Hudsonian.	
	Canadian.	
	Sitkan.	
	Alleghanian.	Humid Warm Temperate.
	Carolinian.	
	Louisianian.	
	Floridian.	Tropical.
	Tamaulipan.	

(Bull. Am. Mus. Nat. Hist., Dec., 1892.)

The Madagascar Fauna.—At a recent meeting of the Royal Geographical Society, Canon Tristram made the following remarks on the Fauna of Madagascar:

"Madagascar has an extraordinary natural history. One would suppose, from its position, that this would be African, but it, like its people, is thoroughly un-African. The monkeys and lemurs of Madagascar are not to be found in Africa, while all the great African animals of prey are absent. Among the lemurs is one known as the ayeaye, the formation of whose digits is unique. The botany is almost as peculiar.

"We saw, at the last meeting of the Zoological Society, a specimen of the egg of an extinct bird of Madagascar, which is fifteen times the bulk of an ostrich egg, and yet the bird itself does not appear to have been larger than—as far as we can judge from remains—the New Zealand moa, an extinct bird, to which it had an affinity. This same peculiarity runs through all the birds of Madagascar. Of course, the water-birds and sea-fowl are the same as those of Africa, but there are one or two extraordinary exceptions. There is the snake-bird, a long-necked bird of very great beauty and grace, allied to the cormorant, which it resembles in its habits, and of which there are four species in the world—the Madagascar one is certainly Indian. Then, again, another puzzling bird to naturalists is the *Mesites*, a water-hen peculiar to Madagascar. These birds are usually distinguished by a small tail and a short tarsus, whereas, the Madagascar, which is related to the others, has a long tail and tarsus, and no one, until M. Audebert, thought the bird was allied to the rails. There is a group of cuckoos entirely peculiar to Madagascar—the coua—of which there are nine or ten species, which have no relations at all in Africa or India. Then, in another group, we have a bird allied to the thrushes, but not African, although allied to a species in the Mauritius and all the Mascarene Islands—the *Hypsipetes*. Altogether, we cannot explain the Madagascar Fauna, but it shows that Madagascar must have been separated from Africa for an infinity of ages; and its natural history affinities are certainly rather with India than Africa, and yet they are entirely distinct and peculiar. No doubt there is a great deal more to be found out than we have yet obtained. The most peculiar specimens seem to come from the northwest part, which, I believe, has been but slightly explored. We know less of it than of any other part, and that leads one to hope that we may still have further specimens, and that we may get something which will throw light generally on the Madagascar fauna, which is represented also in the Seychelles Islands, in the Rodrigues, and in Réunion, also in the Mauritius." (Proceeds. Roy. Geog. Soc., Nov., 1892.)

The Nephridia of Amphioxus.—Boveri, in an article[1] which deserves more space than we can give it, describes the nephridia of Amphioxus, and, in conclusion, summarises his results in the following words: There are present in Amphioxus all the elements of the nephridial system of the Craniata, part with the same function (pronephric tubules), part in combination with other functions (peribranchial chamber=pronephric duct), part in wholly other associations (genital chamber=mesonephric tubules). As in the whole of the rest of its organization, Amphioxus, in its urogenital system, shows in contrast with the Craniata, a condition of simplicity and indifference, which is recapitulated by the latter in their ontogeny.

---

[1] Zool. Jahrbücher. Abth. f. Anat. u. Ontog. V., 1892.

These facts show that we may recognize the conditions of the excretory and sexual apparatus of Amphioxus as primitive from which the relations found in the Craniata have probably developed. Amphioxus is therefore to be taken from its former isolated position, and it shows itself to be, as in all its other organs, so with reference to its urogenital system actually as the primitive type of the vertebrates, as the true primitive vertebrate.

The Position of the Marsipobranchs.—Prof. G. B. Howes has reviewed[2] the various conflicting views as to the systematic position and affinities of the lampreys and hag-fishes, and reconsiders the various structural points of value in that connection. He points out that these forms must be regarded as aberrant gnathostomata; that their urogenital apparatus with that of the Teleosts is the least modified survival of an hermaphroditic apparatus possessed by the ancestors of the vertebrates; that the sucking mouth of these forms has been secondarily acquired, and is not genitically connected with that of the batrachian larva. The arguments from the hypophysis are also considered and assigned great weight, and the rasping tongue is given a greater value in uniting the lampreys and myxinoids than is the sucking mouth. As a result, dismissing, as shown above the term Agnatha for these forms, Howes divides the Vertebrata proper into Epicraniata and Hypocraniata, basing the division upon the position of the hypophysis; the Epicraniata containing only the Marsipobranchs. He has also a secondary division into Euthorchidic and Nephrorchidic series—the lampreys, Teleosts and Dipnoi belonging to the former; all other vertebrates (except, possibly, some ganoids) belonging to the latter series. He thinks that Haeckel's famous aphorism that the Marsipobranchs "are further removed from the fishes than the fishes are from man," fails to express the enormity of the gap between these forms and the higher vertebrates.

Degeneration of the Clitoris.—In a paper read before the American Association of Obstetricians and Gynecologists at the St. Louis, N. W., meeting in 1892, Dr. Robert T. Morris stated that about 80 per cent. of all Aryan American women have adhesions which bind together the glans of the clitoris and its prepuce. These adhesions may bind down the prepuce so closely that not a particle of the glans clitoridis is in sight. They may involve half of the glans, or they may form only a small band. Adhesions which involve the whole, or a large part of the glans clitoridis cause profound disturbances in the physical and mental health of the individual, and probably form the most common single factor in invalidism in young women.

---

[2] Trans. Biol. Socy. Liverpool, VI, 1892.

In compiling statistics upon the subject, Dr. Morris found that preputial adhesions are rare among negresses, and seem to occur only in those possessing a large admixture of white blood.

The author considers the degenerate clitoris a characteristic of the civilized white race. (Am. Journ. of Obstetrics, Vol. xxvi, 1892.)

Zoological News—Reptiles.—Professor O. P. Hay has a valuable paper[3] on the breeding habits, eggs, and young of certain snakes, to which reference must be made by all who wish information on this subject. The same author also notes[4] the ejection of blood from the eyes of the horned toad. The same habit on the part of Phrynosoma has been noted by other observers, but Professor Hay has settled, by microscopic examination, the fact that it is really blood which is squirted out from the outer canthus of the eye.

Dr. Oppel, of Freiburg, i.B., deals[5] with the fertilization of the Reptilian Egg. His observations were made upon *Anguis fragilis*, *Tropidnotus natrix* and *Lacerta viridis*. The article deals with the behavior of the male and female pronuclei and the accessory sperm nucleus, the questions relating to the latter being still left open.

Dr. H. K. Corning, of Prague, deals with some points in the development of the vertebræ and the myotomic cœlom in Anguis and Tropidonotus[6]. The myotomic cœlom persists until after the formation of the neural arches of the vertebræ, hence it is easy to see that the segmentation of the vertebræ results from the formation of inter-vertebral splittings which correspond in position to the divisions between the primitive myotomes. The whole question of resegmentation of the vertebral column is not, says Corning, so simple as has been thought.

The subject of Variation in the snakes of North America, treated of by Cope in a late paper,[7] is taken up by Hay, in his Presidential address before the Indiana Academy of Science,[8] where he finds in four species of snakes that in *Eutaenia sirtalis* the variation from the average number of body vertebræ amounts to 14 per cent., in *Bascanion constrictor* to 6 per cent., in *Cyclophis vernalis* to 4.5 per cent., and in *Diadophis punctatus* to 13 per cent. In the caudal vertebræ the variations amount to 35, 20, 23, and 23.5 per cent. respectively, while in proportion of tail to body the per cents are 9.4, 28, 25, and 35. Hay states that were breeders interested, they could very soon produce breeds of snakes with long bodies and short tails, and short bodies and long tails, or any other combinations that might be desired. The same author has also some interesting notes[9] upon the systematic names and the habits of the species of *Malaclemys*.

---

[3] Proc. U. S. Nat. Mus. XV., 385, 1892; cf. Proc. Ind. Acad. Sci., 1891, p. 109, 1892.

[4] L.c., p. 375.

[5] Archiv. f. mikr. Anat. xxxix., 215., 1892.

[6] Morph. Jahrbuch., xvii., p. 611, 1892.

[7] Proc. U. S. Nat. Mus., xiv., 589, 1892.

A. J. Bigney notes[10] the occurrence of *Elaps fulvus* in Ripley County (south eastern) Indiana.

Some observations on the growth of the rattle of the rattlesnake are given by Dr. Feokistow, who studied specimens sent him from America. He finds[11] that the rattle is frequently shed, and (his snakes were kept in a very warm room) in three or four months two rattles were present, and that their formation has nothing to do with ecdysis. The snakes were made to register the vibrations of the rattle on smoked paper, and it was found that the vibration was a compound one, consisting of the vibration of the tail as a whole, and of the rattle independently of the tail vibrations. The approximate figures of vibrations are given for the tail seventy-five, of the rattle one hundred and ten per "minute."

Mr. W. E. Taylor has published a paper on the Snakes of Nebraska, giving descriptions of both the adult and the young of every species found in Nebraska, together with remarks upon their habits and peculiarities. (Rept. State Board Agric., 1891.)

At the November meeting of the London Zoological Society, Dr. Gunther read a paper descriptive of a collection of reptiles and Batrachians from Nyassa land, transmitted by Mr. Johnston, containing examples of several remarkable new species, amongst which were three new Chameleons, proposed to be called *Chameleon isabellinus*, *Rhampholeon platyceps*, and *R. brachyurus*. (Nature, Nov. 17, 1892.)

[8] Proc. Ind. Acad., 1891, p. 37.

[9] Proc. U. S. Nat. Mus. xv., 1892. Cf. Proc. Ind. Acad. Sci., 1891.

[10] Proc. Ind. Acad. Sci., 1891, p. 151, 1892.

[11] Mélanges Biolog. Acad. Imp. St. Petersburg, xiii. Translated in Annals and Mag. Nat. Hist. vi, xi, 54, 1893.

Batrachia—Mr. Stejneger reports a blind Salamander from Rock House Cave, Missouri. This is one of the most interesting herpetological events of recent years, since it is the first and only blind form among the true salamanders. Mr. Stejneger considers it a new genus of the family Desmognathidæ, and gives a preliminary description of it under the name *Typhlotrition spelæus,* in the Proceeds. U. S. Natl. Mus., Vol. XV.

EMBRYOLOGY.

The Star-fish Larva.—Dr. G. W. Field[1] has published a fully illustrated study of the development of our common star-fish obtained at the U. S. Fish Commission Laboratory, at Woods Holl, Mass. Special attention was directed to the mesenchyme, mesodermal pouches, ciliated bands and watervascular system of the larva with a view to, solving the meaning of the echinoderm larva.

The two symmetrically placed outgrowths of the archenteron acquire connection with the exterior by uniting with two dorsal ectodermal invaginations. These invaginations form two water pores, which are both open for awhile. The one on the right closes up. This double condition is not, as has been maintained, an abnormal condition, but as Professor W. K. Brooks showed, a normal and significant fact.

In discussing the application of these and other facts to the phyllogeny of the Echinoderms, the author holds that–" the Echinoderm ancestor was probably a free-swimming animal, in general characters not far removed from the ancestors of the Turbellarians; a creature with a well-differentiated digestive tract, ciliary locomotor apparatus, excretory system, respiratory surface not localized; cœnogenetrically modified by the acquirement of transparency, long arms and particularly by modification of the external form, by changes in the direction of the ciliated bands, as pointed out by Johannes Müller, into the forms characteristic for the various Echinoderm groups."

Germ-layers of Amphioxus.[2]—Basilius Lwoff has recently published a short paper in which he gives the results of his observations on the early stages of Amphioxus so far as they differ from those arrived at by Hatschek.

He finds that there is no period of rest at the end of the cleavage, at least as far as the smaller ectoblastic cells are concerned, for they continue to divide frequently. This causes a change in the relative position of the cells at the boundary between the micromeres and macromeres, and results in the passive invagination of the entoblast, ectoblastic cells being the active agents.

[1] Q. J. Mic. Sci. 1892.

[2] Biol. Centralblatt, 12, 1892, pp. 729-744, 8 figs.

This multiplication of the entoblastic cells is not equal on all sides, however, but is most frequent on the dorsal side of the invagination; so that the ectoblast becomes invaginated itself at this point and pushing the entoblast before it finally forms the roof of the cavity, while the sides and floor are lined by entoblast. At the same time the margin grows backward and the gastrula mouth gradually closes. In this invagination, then we have two distinct processes: first, the invagination of the entoblastic cells from which the gut is formed, (it is a palingenetic process—the gastrulation); second, the invagination of the dorsal ectoblastic cells; this is to be regarded as a cœnogenetic process, that has nothing to go with gastrulation, but is preparatory to the formation of the chorda and the mesoblast.

Lwoff was unable to find the pole cells of the mesoblast described by Hatschek, and it is interesting to note that more recent observations by E. B. Wilson have had the same result. Lwoff points out, moreover, that even if these cells did exist they could have no connection with the mesoblastic bands; the latter are upon the opposite side from the position assigned to the former.

The multiplication of the cells in the medullary plate causes it to fold inward along the median, and it pushes before it the dorsal wall of the archenteron, leaving a mesoblastic fold on each side. The mesoblast is purely passive in its evagination. The inner half of each fold is composed of ectoblast cells from the roof of the gastrula cavity, and the outer half of entoblast from the side.

The lumen disappears in each mesoblastic segment after it has been constricted off from the general fold. Afterward the true mesoblastic cavity, which is to become the body-cavity, is formed by the separation of the cells in the process of their growth. The body-cavity, therefore, is not a true enterocoel.

The chorda is formed from what is left of the ectoblast in the gastrula cavity, aided, perhaps, by the entoblast at the anterior end. The chordal plate becomes folded outward, and the two sides of the fold are pushed together by the entoblastic cells that at this stage are multiplying rapidly to form the dorsal wall of the gut.

R. P. B.

Epigenesis.—In an interesting review of the history of Evolution versus Epigenesis, Prof. C. Hertwig[3] contributes a few experiments upon the eggs of Triton, to those of Chabry, Fiedler, Driesch and others all tending to overthrow the position occupied by Roux and

---

[3] Entwichlungs-Theorieen, Berlin, 1892.

Watase regarding the pre-formation and early localization of embryonic organs. While Roux held that the frog's egg is a mosaic in which definite regions must become certain organs, the following experiment of O. Hertwig seems to show that this is unlikely in the related form, the Triton.

When the egg of *Triton palmatus and T. cristatus* taken in May and June 1892 was dividing into two cells, a delicate silk thread was passed around it and drawn together so as to gently squeeze the two first cells somewhat apart. This made the egg somewhat dumb-bell shaped.

Each cell divided and finally an embryo with chorda, somites and nerve tube was formed. As the embryo was not formed so as to lie with its left on one of the hemispheroid parts of the egg and its right upon the other, we may conclude that the first cleavage did not divide the Triton egg so as to separate its right-forming from its left-forming material. The right and left halves are not separated by the first cleavage. In fact in one case the thread separated the head from the tail region.

It is only, the author thinks, by understanding the multiplication of the egg as an organism and the gradual interaction of the numerous cells of any stage that we can arrive at a true conception of the epigenesis-like formation of an embryo.

Form and Chemical Composition.—Curt Hebst[4] of Zurich has published a series of experiments made at Naples and at Triest in the endeavor to determine if the form of organic structures is dependent upon their chemical composition. To this end the eggs of sea urchins, (three species were tried), were reared in sea water to which definite, small amounts of certain salts were added. The salts used were $LI Cl$, $Li Br$, LiI, $Li NO_3$, $Li_2 SO_4$, $Na Br$, NaI, $Na_2 SO_4$, $Na NO_3$, $K Cl$, KBr, KI, $K NO_3$, K_2, SO_4, $RhCl$, $CsCl$, $Mg SO_4$ and $Ca Cl_2$; the results obtained were certain peculiar forms of larvæ, and the explanation adopted for the results was that the salts acted osmotically, not by altering the chemical constitution of the eggs.

Before speaking of the character of the larvæ reared under these abnormal conditions we will first note a few incidental results sometimes seen. One is that in a number of eggs, two blastulæ were seen inside the egg membrane so that separate twins had been formed from one egg. Again it was sometimes observed that only part of the cleavage cells formed the blastula, the rest remaining as an irregular mass within the same egg membrane. These facts favor the views of Driesch as to the equality of the cleavage cells in the echinoderm. Another peculiar result sometimes followed the addition of salts, namely, the production of twin gastrulæ or plutei (without processes) or even of multiple larvæ all to be regarded in these cases as due to *fusion*. The author entertains no doubt, that by some change in the character of the ectoderm cells the larvæ first adhere and then fuse till there are formed complete twins with two separate mouths, ani and (incomplete) skeletal systems, though but a single body space.

---

[4] Zeit. f. wiss. zool. 55, Dec., 1892.

Coming to the main results of the experiments, we find that two peculiar larval forms, the *potassium larvæ and the lithium larvæ* may be formed instead of the normal larvæ when salts of potassium or of lithium are added to sea water.

The potassium larva is simply a pluteus with its normal digestive tract and cilia but without the characteristic pluteus processes or arms and with little or no skeleton. As an example of the amount of material necessary to effect this result may be cited one experiment in which eggs fertilized in normal sea water were put into 860 ccm. sea-water diluted by 140 cm. of 3.7% KNO_3 solution. The larvæ lived for fourteen days but had scarcely any or no skeleton and no arms.

The absence of the skeleton is regarded as the chief thing determining the absence of the pluteus arms; these, it is believed, naturally growing as they are constantly stimulated by the growing skeleton. The cells to form the skeleton may be properly arranged, but do not secrete the lime salts to form the skeleton.

This kind of larva may be formed by other salts than those containing potassium. The lithium larva, however, is formed only by salts containing lithium.

This latter form may be described as two vesicles attached to one another by a hollow stalk. One vesicle has a thicker wall and finer cilia on its outside, the other a thin wall and fewer, longer cilia on its outside. This larva is actually formed by the elongation of a normal blastula followed by a partial abstriction into two vesicular portions.

It is regarded, however, as having the morphological value of a gastrula which has grown in an evaginated form so that the thicker walled vesicle represents the entoderm and the other the ectoderm.

One experiment taken at random will serve to illustrate the amount of salts used; to 1950 ccm. sea-water 50 cm. 3.7% LI Cl solution were added; the characteristic double vesicle larva were formed, but all died on the eighth day.

Most interesting differences obtain amongst the various salts of lithium in the strength of their action. If the eggs of the same sea urchin are treated simultaneously with the various salts we find that at a given time the larvæ were not all equally far advanced, equal amounts of the some salts acting sooner than others in producing the lithium larva, and larger amounts of some salts being necessary to produce the same results as smaller amounts of other salts of lithium.

From a table of such experiment the author concludes that Li Cl, Li NO_3, Li Br, and LiI are less and less active in this order which is also the order of increasing molecular weights. Thus in these experiments where the same per centage of salts was always used the heavy molecules were less numerous and less active; the action of these salts in producing the lithium larva diminishes with the number of molecules used. This rule, however, finds an exception in $Li_2 SO_4$.

In Na Cl, Na NO_3, Na Br, and Na I as well as in K Cl, K NO_3, K Br and KI we find again the same rule; the larger number of molecules being most efficient in forming the so-called potassium larvæ, and so on down to the heaviest. The results hold only for salts of the same metal.

Now since it is known from the work of H. De Vries and others that osmotic pressure is associated with the number of molecules in a given volume, increasing with diminishing molecular weight we find so close a similarity between the effects of salt upon larvæ and their osmotic action, that we may conclude, the author thinks, that these effects are due to their osmotic action.

Thus the potassium larva is to be regarded as the result of disturbing those chemical processes which would have normally formed a lime skeleton, and this disturbance is by the removal of water osmotically. Again the lithium larva may be regarded as due to some peculiar impermeability of sea urchin larval cells toward salt of lithium; this produces strong osmotic pressure. The pressure is not regarded as working in a gross mechanical way, but rather as a stimulus that causes the larval cells to grow in an abnormal way.

Though this explanation leaves no room for chemical changes as a source of change of form in these echinoderm experiments, yet the author is inclined to think that in some cases, as in the formation of galls, chemical changes of the protoplasm may cause the changed form that results.

The application of this study in experimental embryology is that the normal course of ontogeny is dependent upon the conditions of osmotic pressure within and without the body.

ENTOMOLOGY.[1]

The Pear-Tree Psylla.—During the last two or three seasons many pear orchards in Connecticut, New York and other States have suffered severely by the attacks of a small jumping plant louse of the family Psyllidæ. This insect is supposed to have been imported from Europe early in the present century, having been first noticed in Connecticut. It now occurs throughout many of the Northeastern United States, and as far west as the Mississippi Valley.

In a recent discussion of this insect in Bulletin 44 of the Cornell University Experiment Station, Mr. Mark V. Slingerland records one of the most notable pieces of entomological work done since the establishment of the stations. After an introductory paragraph indicating the recent losses due to the pest the author considers its past history in America; its place in zoological classification; the indications of its presence; the appearance of the immature and mature insect; its life history in detail, and the methods of preventing its ravages, all of which is followed by a series of technical descriptions and a full bibliography. One of the interesting points brought out is that the species is dimorphic, the summer form having been described as one species, and the winter form as another. Concerning this the author writes:

"This difference between the summer and the winter adults is common among the *Psyllidæ,* and has before led to their being described as different species. It seems not to have been suspected that these insects were truly dimorphic or appeared in two distinct forms during the year. The general impression seems to have been that the adults appearing in the fall were at first the same as the summer form; and that as winter approached these adults gradually assumed the characteristics of the hibernating form. However, frequent observations upon *Psylla pyricola* in the field during August and September, 1892, have shown that from eggs lain about August 20th by typical summer adults, there hatched nymphs which showed no variations from the typical summer nymphs and from these nymphs there emerged about September 25th the distinct hibernating form *simulans.* The hibernating forms feed until the leaves fall and then seek their hiding places in which to pass the winter. None have been seen to copulate in the fall. But very few summer forms were seen after September 20th.

---

[1] Edited by Clarence M. Weed, Hanover, N. H.

Thus in our Pear-tree Psylla we have a case of true dimorphism. The summer form is the typical *Psylla pyricola*, and may be designated when necessary to refer to this form alone as *Psylla pyricola pyricola;* while the hibernating form should be known as *Psylla pyricola simulans.*"

Experiments showed that the immature stages of the Psylla were easily destroyed by spraying with kerosene emulsion. We are indebted to Mr. Slingerland for the use of the engravings on the accompanying plate, showing the stages and structure of the insect. Fig. 1 represents the adult insect; fig. 2, its head and antenna greatly magnified; 3, the abdomen of the male; 4, the abdomen of the female; 5, the wings; 6, the full-grown nymph, and 7, the egg.

Insects of Southern Alaska.—An important contribution to our knowledge of the coleopterous fauna of Southern Alaska has recently been made by Mr. H. F. Wickham,[2] who has published some of the results of a collecting trip made during the summer of 1891. The points visited were Fort Wrangel, mainland near Wrangel Island, Yes Bay, Loring, Hunter's Bay and Port Chester in Alaska, and the Stikine River Valley and Glenora in British Columbia. From his studies Mr. Wickham concludes (1) "That the fauna of Southern Alaska is less closely related to our alpine, northern inland or northeast coast faunæ than is that of the Stikine Canyon or of Glenora. (2) That the Stikine Canyon fauna is more closely allied to that of the north and east than is that of the coast, and about the same as is that of Glenora. (3) That the chief relations of all three are in the direction of Lake Superior. With larger lists this affinity might turn to the Rocky Mountains, especially in the case of Glenora."

Notes on Ohio and Other Phalangiidæ.—A recent study of a large collection of harvest-spiders (*Phalangiidæ*) from all parts of Ohio shows that the State is unusually rich in these interesting Arachnids. The following species occurred in the collection:

1. *Liobunum vittatum* (Say) Weed.
2. *Liobunum vittatum dorsatum* (Say) Weed.
3. *Liobunum nigripalpis* (Wood) Weed.
4. *Liobunum nigripes* Weed.
5. *Liobunum politum* Weed.
6. *Liobunum longipes* Weed.

---

[2] Entomology of Southern Alaska, Bull. Nat. Hist. Labrt. Iowa State Univ., V. ii, pp. 202–233.

7. *Liobunum ventricosum* (Wood) Weed.
8. *Liobunum bicolor* (Wood) Weed.
9. *Liobonum* (?) *calcar* (Wood) Weed.
10. *Liobunum maculosum* (Wood) Weed.
11. *Liobunum grande* (Say) Weed.
12. *Liobunum grande* var. *simile* Weed.
13. *Mitopus pictus* (Wood) Weed.
14. *Mitopus ohioensis* Weed.
15. *Phalangium cinereum* Wood.

An examination of more than fifty specimens of a harvest-spider in various stages of development taken along the banks of the Maumee River in Henry County, leads to the conclusion that the form from Illinois described some years ago as *Liobunum elegans* is an immature stage of the male of *L. bicolor*. A reexamination of the type specimen of *Mitopus ohioensis* after it has been in alcohol more than four years shows that it was apparently just ready to moult when captured. This gives rise to the suspicion that this is an immature form of *M. pictus*, the pink coloring possibly being due to the peculiar conditions of the moulting period.

The study and measurement of a considerable number of specimens of *Liobunum ventricosum* from many States shows that this species increases in size to the southward in a way similar to that of *L. vittatum*. The southern form is evidently sufficiently distinct for a subspecific name, and as the form now standing as *Forbesium hyemale* is pretty certainly an immature stage of it, the subspecies may well take its name and be known as *L. ventricosum hyemale*.

Illustrated papers on both these subjects are ready for the printer, and will appear in the near future.

Professor C. H. Tyler Townsend, of the New Mexico Agricultural College, recently sent me specimens of an undescribed species of Liobunum taken at Las Cruçes. It may be called *L. townsendii*. Its description is as follows:

Male.—Body 5 mm. long, 3.7 mm. wide; palpi, 5 mm. long. Legs, first, 43 mm.; second, 80 mm.; third, 45 mm.; fourth, 59 mm. General color of dorsum brown, approaching raw umber, with indistinct darker blotches, but no central marking. Ventrum light grayish brown. Palpi similar in color to ventrum, with dorsal surface of patella and of tip of femur darker brown. General color of legs raw umber, with whitish rings near articulations and blackish ones at articulations. Dorsum minutely tuberculate; articulation of the three posterior segments very distinct. Eye eminence rather high, nearly square as seen from above; canaliculate; smooth except for two sparse rows of spinose hairs. Palpi rather long, slender, with no projecting angles; clothed with rather short hairs and a few minute spinose tubercles; claw slightly pectinate near base. Mandibles normal; light brown with tips of claws black. Femora angular. Second legs much more slender than others.

Female.—Body 7 mm. long, 5 mm. wide; palpi 4.5 mm. long. Legs, first, 35 mm.; second, 61 mm.; third, 37 mm.; fourth, 46 mm. Differs from the male chiefly by its larger body and shorter legs.

Described from three specimens (1 ♂ 2 ♀).—CLARENCE M. WEED.

Gall-Producing Insects.—Mr. Wm. Beutenmüller, of the American Museum of Natural History, publishes[3] a useful Catalogue of Gall-producing Insects found within fifty miles of New York City. Eighty-eight species are enumerated, the family distribution of which is: Cynipidæ, 40; Tenthredinidæ, 2; Cecidomyidæ, 32; Tripetidæ, 2; Psyllidæ, 5; Aphididæ, 6; Acaroidea, 1. The next to the last family is called Aphidæ instead of the more correct Aphididæ. "The vegetable deformations called galls," writes Mr. Beutenmüller, are produced by insects. Generally an egg is inserted in a bud, a leaf, a root, or some other part of the plant, and the presence of this foreign body among the vegetable cells causes an abnormal growth of a definite shape. The variety of galls in respect to texture and substance is very great. Every species of gall-producing insects attacks its own particular plant, and a particular part of that plant, and produces a gall of a definite and uniform structure." The two plates accompanying (due to the courtesy of the author) show a variety of common galls. Plate (III) represents those made by the minute two-winged flies of the genus Cadomyia; and (IV) those made by the four-winged flies of the family Cynipidæ.

Recent Publications.—Mr. Henry G. Hubbard publishes[4] an extended description of the larva of *Amphizoa lecontei*, illustrated by an admirable plate. He extends Schiödte's table of the larval characters of the principal families of adephagous coleoptera.

Through the cooperation of the Massachusetts Society for Promoting Agriculture, the Hatch Experiment Station of the Agricultural College has issued an edition of 45,000 copies of a bulletin concerning canker-worms, tent caterpillars, fall web-worms and tussock moths written by Professor C. H. Fernald. A special attempt is being made to induce the people of the State to suppress these pests. The author states that "There has been such culpable negligence on the part of many of our people with regard to the tent caterpillar that there can be no doubt that some legislation is needed to compel the negligent to destroy this pest on all the trees on their own land, and thus prevent it from extending to the trees in the surrounding orchards. Provision should be made for the destruction of tent caterpillars on all public lands as well as in the forests, and village improvement societies should urge such action in town meetings as shall make it the duty of the superintendent of roads to destroy all tent caterpillars on the trees and shrubs along the sides of the roads."

---

[3] Bull. Am. Mus. Nat. Hist., V. iv, Art. xv.

[4] Proc. Ent. Soc. Wash., ii, pp. 341–346.

Mr. S. H. Scudder's Monograph of the Orthopteran Genus Hippiscus which has been running through *Psyche* for some time has been issued as a reprint. The thirty-eight species are grouped under the subgenera Hippiscus, Sticthippus, and Xanthippus.

Two interesting papers on the Butterflies and Crickets of Indiana have been published by Mr. W. S. Blatchley, of the Terre Haute High School. The former is extracted from the 17th Report on the Geology and Natural History of Indiana, and the latter from the Proceedings of the Indiana Academy of Science, 1891.

Mr. Wm. Beutenmüller records in the Bulletin of the American Museum of Natural History (v. IV, Art. XIII) an important List of Types of Lepidoptera in the Edwards Collection of Insects. This collection (made by the late Henry Edwards) " consists of about 250,000 specimens and about 25,000 species, representing all the orders and gathered in various parts of the globe. It is especially rich in Australian species and in North American species from the Pacific Coast. The present list enumerates 465 types of species.

The department of entomology of the University of Kansas has recently published a bulletin of 126 pages concerning "Common Injurious Insects of Kansas," prepared by Vernon L. Kellogg. The paper is well illustrated and will prove valuable to Kansas farmers.

PSYCHOLOGY.

The Sense of Taste in a Sea-Anemone.—It is a well known fact that sea-anemones possess a faculty which enables them to recognize food. This sense has been recently studied by M. Nagel of the Zoological Station at Naples. The following is one of his experiments. A small piece of sardine was gently pushed toward the tentacles of a sea-anemone; the morsel was first touched, then seized, then swallowed. A small ball of blotting-paper, similar in appearance, saturated with sea-water was next offered, but it was not taken. The paper was then saturated with the juice of the fish, when it was seized with the same avidity as the bit of sardine, but often it was rejected after the lapse of a few moments.

When the blotting-paper is impregnated with quinine the tentacles recoil. The quinine does not affect the external surface of the body, except the part situated between the tentacles and the mouth. If food is placed in the mouth, or near the open mouth, the animal does not notice it, but will only take it when the tentacles have touched it. The sense of taste, then, is localized in the tentacles, which serve as organs of touch; and also appreciate changes of temperature. (Revue Scientifique, Dec. 1892.)

M. Vaillant on the Feeding of Snakes.—In a paper read before the *Academie des Sciences de Paris*, M. Léon Vaillant made the following interesting remarks concerning the alimentation of Snakes. These remarks were the result of a series of observations of a large Anaconda from South America, *Eunectes murinus*, one of the Boidae, about 6 meters long, which, contrary to the usual habits of this species accepted food very soon after its arrival at the menagerie of the Reptiles of the Museum, and has continued to eat with regularity up to the present time. In fact, since its entrance into the Jardin des Plantes, August 8, 1885, until the end of the year 1891, this serpent has eaten 34 times, or about 5 times a year. Its food has generally been small or young goats; three times it took a hare and once a goose. The intervals between the times of feeding have varied from 23 days to 204 days; this last interval occurred but once. The snake decided for itself the time for feeding, manifesting its desire by increased activity, and by other signs.

As to quantity of food, in order to avoid all accidents which might result from indigestion, the Anaconda was given animals of moderate size; the largest it has swallowed is a kid of about 12 kilograms weight; which represents one sixth the weight of the snake. There is no doubt, however, that in a wild state, a snake of its size could swallow animals three or four times as large.

M. Vaillant adds, in this connection, the following fact which shows the stretching capacity of certain snakes. In the menagerie of the museum, a viper from France, (*Pelias berus*) had to be put in the same cage with a horned viper, (*Cerastes.*) As the individuals, although they belonged to different species, were about the same size, it was supposed that they would live peaceably together. It was a mistake. During the following night the *Cerastes* swallowed the *Pelias berus*, and in order to accommodate himself to his huge prey, his body was distended so that the scales which touch each other laterally, and even lap in its normal state were now so spread apart that between the longitudinal rows, a bare space equal in size to the scales was left. Digestion went on regularly, however, and the *Cerastes* did not appear to suffer.

The author also remarked that snakes in general do not accept indifferently all sorts of food, but appear to exercise a choice. It is often difficult to induce a snake to take food for the first time, but once this is accomplished, it accepts more readily succeeding proffers. A *Pelophilus madagascariensis* has been known to refuse a variety of food for 22 months, when it ate a starling, then a few other small birds and finally some rats, which are still fed to him without any difficulty, although previously they had been offered to him in vain.

M. Vaillant also remarks that the residue of digestion are evacuated at a single time after each feeding, at the end of a certain number of days. However, it often happens that the fæces contain the residue of a former meal. (Revue Scientific, aont, 1892.)

ARCHEOLOGY AND ETHNOLOGY.[1]

International Congress of Americanists.—It is proposed in this department to make a series of sketches of some of the International Congresses held in Europe. Two of these Congresses, to wit, that of "Criminal Anthropology," of Brussels, and that of the "Americanists," at Huelva, voted to hold a special meeting in the United States during the Summer of 1893; both, presumably, to be at Chicago. The increased interest thus to be engendered justifies this publication.

THE FIRST INTERNATIONAL CONGRESS OF AMERICANISTS.—On the 25th of August, 1874, the Société Geographique Française held a meeting in the City of Paris, and formulated a Constitution, which should serve as a foundation for a new Society, to be called the Congrès Internationale des Americanistes.

The object was to contribute to the progress of Ethnographic, Linguistic, Historic studies relative to North and South America, and especially those of antiquity. The Historic or Proto-Historic portion would naturally be directed to the time of the discovery by Christopher Columbus.

Committees were appointed, officers and their duties provided, requisites of membership laid down, all in the shortest and simplest manner possible, and it finally provided that the First Congress should be held at the City of Nancy, on the 19th of July, 1875, and to continue four days.

The First Congress was entirely successful, and demonstrated the good judgment of its founders.

Twenty-eight countries were represented. Professor Henry, Secretary of the Smithsonian Institution, and Hon. Robert T. Winthrop, General Clary and Professor Henry W. Haynes, of Boston, were delegates from the United States; although it does not appear that the two former were present.

The report of the Treasurer showed 1572 subscriptions at 12 francs each, with total receipts of 23,106 francs. The meetings were held in the Ducal Palace, at Nancy, under Government patronage and protection; the city was put in gala costume, the palace and streets were draped with the flags of all nations, and there were the usual excursions, receptions, fêtes, concluding with the official banquet.

---

[1] This department is edited by Dr. Thomas Wilson, of the U. S. National Museum.

There was an Exposition of American Antiquities, principally from the collections of the Archeologists of two countries; the most extensive being that of a most esteemed friend, M. E. Boban, of Paris and Mexico.

The papers read and the subjects discussed are here given to show the scope of the organization.

Discovery of America before the time of Columbus, by M. Benedict Grondals, 7 pages; Discovery of the New World, by M. E. Beauvois, 52 pages; The Pheniciens in America, by Gaffarel, 48 pages; Buddhism in America, by M. Foucaux and M. De Rosny, with discussion, 12 pages; Fou-Sang, by Lucien Adam, 18 pages; Atlantis, by M. Chill y Naranjo, 3 pages; The Dighton Rock, by M. G. Gravier, 26 pages; A Dream of Christopher Columbus, by M. Castaigne, 23 pages; Inscription on the Grave Creek Tablet, by M. Levy Bing, 17 pages; America and the Portuguese, by M. Luciano Cordiero, with discussion by Professor Haynes, 97 pages; The Arctic and Antarctic Regions, by M. Daa; The Esquimaux, by R. P. Petitot; The Indians of the United States, by M. De Semallè, 9 pages; The Ancient Races of Peru, by M. John Campbell, 19 pages; Columbian Skulls, by M. Paul Broca, 16 pages; The Aborigines of Haiti, by Madiou; The Tradition of the White Man, by Madier De Montjau; An Iroquois Manuscript, by Leon De Rosny; The Mound Builders, by M. Joly; The Indians of French Guiana, by M. Dupont; The Caribs, by M. Ballet; The Origin of America, by Baron de Bretton; The Indians of Peru, by M. Ber; Le Maguey, by M. Gordron; The Guano of Peru, by M. Ridel; Language of the Cheyenne Indians and the Quichua, by Lucien Adam, 7 pages; Les Déné-Dindjies, by R. T. Petitot, 24 pages, and An Iroquois Manuscript; The Relation of Words, by Lucien Adam, 6 pages; Comparison between the Basque Language and Indian Languages of America, by M. Julien Vinson, 14 pages; Deciphering the Maya Language, by Leon De Rosny, 5 pages; Central America, by M. Blaise, 2 pages; The Society of Quakers, by M. Magnin; The Crees and the Chippeways by Lucien Adam, 59 pages; Anthropology in the Antilles, by M. Cornilliac, 22 pages; Traditions of the Greenlanders, by M. Rink and Valdemar Schmidt, 9 pages; The falsity of the Hebrew inscription found on a stone at Newark, Ohio, by M. Henry Harrisse, 7 pages; America in Antiquity, by Francis A. Allen, 47 pages; Asiatic Emigration to the New America, by R. P. Petitot, 11 pages; Ancient Mexican Stirrups, by Eugene Boban, 3 pages; Archeologic Analogies, by M. Morey, 7 pages; Prehistoric Canada, by M. Le Metayer-Masselin, 8 pages; The Museum of St. Petersburg, by M. Schoebel, 3 pages; Ancient American Music, by Oscar Comettant, 27 pages; Alphabet of one of the Ancient Languages in the interior of South America, by M. Pacheco-Zegarra, 28 pages; Memoire on the numeration of the Maya Language, Leon De Rosny, 20 pages.

THE SECOND INTERNATIONAL CONGRESS OF AMERICANISTS was held at Luxembourg, from the 10th to the 14th of September, 1877. There were 1047 subscriptions, and the total receipts, including contributions, amounted to 18,338 francs. Twenty-seven countries were represented.

The titles of the papers presented and addresses delivered are as follows:—

The Ancient Pueblos, by Edwin A. Barber, 17 pages; The Mound Builders, by Mr. Robert S. Robertson, 26 pages; The Chinese in California, by M. Emile Guimet, 9 pages; Osteologic Evidence furnished by the Ancient Mounds of Michigan, by Mr. Henry Gillman, 15 pages; The Origin of Civilization in the New World, by Mr. F. A. Allen, 20 pages, with the Protestation, by M. L'abbe Hengesh, 4 pages; The Mound Builders, by Mr. S. D. Peet, 17 pages; To What Race Belonged the Mound Builders? by Judge M. F. Force, 25 pages; The Origin of the Language, Mythology and Civilization of America, found in the Old World, by Mr. Hyde Clarke, 14 pages; The History of America and its Discovery, by Mr. De Hellwald, 4 pages; The European Colonies in Markland and l'Escociland, in the XVI and XVII Centuries, by M. E. Beauvois, 61 pages; A Comparison between the Civil Legislation of the Mexicans under the Aztec Emperor, and of the Peruvians during the epoch of the Incas, by Sr. J. F. Nodal; The Route of the Mississippi, by M. Gabriel Gravier, 75 pages; Points or Marks in the Chronology of the History of the Mound Builders, by M. Stronck, 13 pages; The Migration of the Nahuas, by J. H. Becker, 26 pages; Address of Mr. Da Silva Paranhos and his criticism of the work of M. le Doctor Couto deMacalhaes, entitled "O Selvagem" or the Savage, being an investigation into the Antiquity of Man in South America, and especially in Brazil; Americus Vespucci, by Dr. Schoetter, 3 pages; Theories on Ka-kwaks, and their destruction by the Senecas, by Abbe Schmidt; Conquest of the Ancient Chilleans by the Peruvians in the times of the Incas, by M. H. Savary, 2 pages; Pay-Tuma, by Abbe Schmidt, 6 pages; Prehistoric Synchronism, by M. Anatole Bamps, 29 pages; The Discovery of Brazil by the French, by M. P. Gaffarel, 37 pages; Memoirs of Brazil, by M. Burtin; the voyage of Verrazzano, by M. Desimoni; The Ethnographic distribution of Nations and Languages in Mexico, by M. V. A. Malte-Brun, 36 pages; The Language Atacameña, by M. Moore, 22 pages; The Manuscript of M. Platzmann; The Indian Languages of America compared with the Ural-altaischen Languages, by Forchhammer, 19 pages; Is the Quichua an Aryian language? Being a critical examination of the works of Don V. F. Lopez; The Aryenne Races in Peru, by M. V. Henry, 83 pages; An inscribed tablet, by M. J. Gass, 2 pages; The Engraved tablet of Rockford, Illinois, and its evident fraudulent character, by N. Moody; A grammatical examination and comparison of 16 American Languages, by M. Lucien Adam, 83 pages; Principles of the Cree Language, by M. R. P. Remas, 10 pages; The Age of Stone, at the exposition of Philadelphia, 5 pages, by Emile Guimet; The National Library of Rio Janeiro, by Ferdinand Denis, 8 pages; American Antiquities in the Royal Netherland Museum at Leyden, by M. Leemans, 20 pages; A chapter in American Archæology, 16 pages, by C. Schoebel; A rock-shelter in Pennsylvania, by Mr. S. S. Haldemann, 8 pages; A primitive habitation of the Esquimaux, by M. H. Rink, 14 pages; The antiquity of Man in America attested by the Silex. The evidence upon which this paper relies to prove its proposition, is the similarity of the flint implements of America with those of Europe, by Jean Engling; The collection of M. Emile de Ville, Belgium Consul at Quito, and its proposed deposition or gift to the city of Brussels and its deposition in that Museum; Antiquities of Greenland, by M. Valdemar Schmidt, 3 pages.

THE THIRD INTERNATIONAL CONGRESS OF AMERICANISTS was held at Brussels, from the 23d to the 28th of September, 1879.

The number of Nations represented was about the same at the two previous Congresses; while the number in attendance, and the papers read and addresses made were greater. The proceedings were reported in two large volumes containing together 825 pages, with an atlas of plates.

The following papers were read and addresses delivered:—

Pre-Columbian Historic Documents from Mexico and Anahuac, by M. Andre de Bellecombe, 13 pages; The Calpullis of Mexico, their administration, origin and communistic principles, by Mr. Ad. F. Bandelier, 3 pages; The Norambégue, with the proof of its Scandinavian origin furnished by the language, institution and belief of the Aborigines of Acadia, by M. Eugene Beauvois, 38 pages; The exploration of the Amazon by the Franciscans of Peru, by P. Servais Dirks, 31 pages; Progress of American Cartographie during the XVI Century, by Rev. F. B. De Costa, 8 pages; The same (Continued) by

M. Gabriel Gravier and by Lieut. Col. Adan, 89 pages; An unknown chart, the first one made by Louis Joliet in 1674, after his exploration of the Mississippi with Father Marquette in 1673, by M. Gabriel Gravieri with explanations by M. Lucien Adam, 38 pages; Observations on the earlier letters of Americus Vespucius, by Judge M. F. Force, 36 pages; On the influence of orography on the march of civilization in America and Europe, by Dr. Charles Barrois, 4 pages; Printing and Bookmaking in Spanish America, from the XVI to the XVII Century, by Vicente G. Quesada, 68 pages; The antiquity of different Canadian States, by M. Burtin, 3 pages; Verraxxano, discoverer of certain regions in North America, by Cornelio Desimoni, of Genoa, 67 pages; The Carib Language, and the differences between it as spoken by men and women, L. Adam; Peruvian Ceramics in the Society of Americanists at Nancy, by M. Jules Renauld, 20 pages; Christianity and the White Man in America before its discovery by Christopher Columbus, by Abbe Schmitz, 15 pages; The White Man and the Cross in America, by M. Peterkin, 20 pages; The White Man and the Cross in Peru before the Discovery by Columbus, by D. Marcos Jiminez de la Espada, 28 pages; Collection of M. Guesde, of Port-au-Prince, specially the Carib stone hatchet, 3 pages; American Antiquities recently acquired by the Royal Netherland Museum of Antiquities at Leyden, by Dr. Leemans, 3 pages.

Antiquities of Greenland, by Valdemar Schmidt, 6 pages; The last discoveries in the Mounds of America, by Rev. J. Gass, with a letter from M. Francis A. Allen, 26 pages; Effigy Mounds in America compared with those of the same kind in Europe and Asia, by Dr. Phéne, 7 pages; The probable destination of the Inca-Chunca, by Jean Van Volxem; Antiquities from the Equator at the Royal Museum at Brussels, by Anatole Bamps, 96 pages; The antiquities from the valley of San Augustine, United States of Columbia, by M. Jose Maria Gutierrez de Alba, 5 pages; The discourse of Dr. Virchow; The influence of American surroundings upon the White Race, by M. Grattan, 8 pages; Existence of Man in North America during the Glacial Period, by M. Sidney Skertchly, 4 pages; The reefs of St. Paul and the question of Atlantis, by Abbe Renard, 22 pages; The last of the Mexican Races in the United States; by M. Edwin A. Barber, 6 pages; The highest antiquity of Man in America, by M. Florentine Ameghino. This paper has reference to the man during the tertiary period in Brazil, 52 pages; Cosmogonye Algique, by Count de Charencey, 28 pages; Origin of the Primitive Indians of South America; by Mme. Marcella J. Wilkins, 8 pages; A critical examination and comparison of fourteen

American Languages, by M. Lucien Adam, 61 pages; Grammar of the Moskito Language, by Edward Grunewald, and Dictionary of the same, Moskito and German; Inscribed Stones purporting to be in Hebrew, from Licking County, Ohio, by M. Charles Whittlesey; A comparative grammar of three languages of Greenland, by Victor Henry; A comparison between the Aymara of the Quichua and the dialect of Quito, by Jose Fernandez Nodal; Principles of Language and Othomie, by Professor de Harlez, 45 pages; The Affiliation of American languages, by M. John Campbell; A Communication on the Idol of Guaqui, by M. Marcos Jiminez de la Espada; Philologic Notes, by M. P. Vegreville, 39 pages; The Mexican Calendar, by Manuel Orozcoy Berra; Ancient inscriptions in the Argentine Republic, by Florentine Ameghino, 27 pages; Prehistoric Clocks in South America; The language Maskoki and its dialects, by M. Albert S. Gatschet, 16 pages; The deciphering of certain Maya characters, by the Count de Charency.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society of Naturalists.—This body met at Princeton, N. J., in J. C. Green Science Hall of Princeton College, on December 28–9, 1892. Professor Osborn, of Columbia College, N. Y., was President, and Professor T. H. Morgan, of Bryn Mawr College, Pa., was Secretary. On the afternoon of Dec. 28th, President Patton, of Princeton College, gave an address of welcome. A committee was appointed to confer with the executive committees of the affiliated societies to bring about a union between the societies of Morphologists and Anatomists. Professor Sedgwick read a report by Professor S. F. Clark, on Science Teaching in Schools. Reports on Marine Biological Laboratories were presented by Dr. E. A. Andrews, of Johns Hopkins University on the Marine Station in Jamaica; Dr. D. Bashford Dean read a paper on the Marine Laboratories of Europe, which was handsomely illustrated; Professor C. O. Whitman read a paper on the Outlook of the Marine Laboratory at Woods Holl, Mass. Dr. Stiles read a report of progress in obtaining support for an American table at the Marine Laboratory at Naples. The Society adopted resolutions favoring the establishment and continuous support of a table at that Laboratory.

In the evening the Annual Dinner took place in University Hall After the address by the President, Professor Osborn, remarks were made by Professor Brewer, of Yale, Professor Cope, of Pennsylvania, Dr. Heitzman, of New York, Professor Minot, of Harvard, and others.

On Dec. 29th, the following members were elected: Howard Ayers, J. H. Bamhart, G. W. Calkins, T. M. Chapman, D. Bashford Dean, D. G. Elliot, B. D. Halsted, Ida A. Keller, Edwin Linton, T. B. Lotsy, J. I. Peck, H. S. Pratt, J. E. Reighard, Wm. E. Ritter, J. P. Smith, O. S. Strong, R. Thaxter, H. H. Wilder, Arthur Willey, J. L. Wortman.

Professor Libbey offered the following resolution, which was carried: That a committee be appointed to bring about an affiliation of the Physiological, Morphological, Anatomical and Geological Societies with this body.

New Haven was adopted as the next place of meeting. The following officers were elected for the ensuing year: President, Professor R. H. Chittendon, New Haven; Vice-Presidents, Professor G. Baur, Chicago, and Dr. Wm. H. Dall, Washington, and Professor Wm. Libbey, Princeton; Secretary, Professor T. H. Morgan, Bryn Mawr, Pa.;

Treasurer, Professor W. T. Sedgwick, Boston; Executive Committee, Professor W. G. Farlow, Cambridge; Professor J. A. Ryder, Philadelphia.

Special reports on the work of the preceding season were made by Professor W. Libbey, Jr., on the summer work of the U. S. Fish Commission schooner, Grampus; by Dr. J. L. Wortman on the Exhibitions of the American Museum of Natural History in New Mexico, Wyoming and Dakota; and by Professor E. D. Cope on the Paleontological Exploration of the Staked Plains of Texas by the Geological Survey of Texas.

On Dec. 29th the Annual Discussion took place. The question was, What were the former Areas and Relations of the American Continent as determined by Faunal and Floral Distributions? The discussion was opened by a paper from Professor W. B. Scott, of Princeton, on "Evidence from past and present Distribution of Mammalia." Professor J. A. Allen read a paper on the Evidence from the Distribution of Birds; and Dr. N. L. Britton on Evidence from the Distribution of Plants.

American Morphological Society.—The annual meeting was held at Princeton, N. J., Dec. 28–29, 1892. The following papers were read: Dr. E. B. Wilson, Columbia College, The cleavage of the ovum and the teloblasts of Amphioxus. Dr. C. W. Stiles, Department of Agriculture, Washington, The topographical anatomy in the family Tæniadæ. Dr. E. O. Jordan, University of Chicago, The maturation and Fertilization of the egg of the Newt. Professor E. D. Cope, Philadelphia, False Elbow Joints in Man and the Horse. Mr. Arthur Willey, Columbia College, On Acinetæ parasitic in the buccal tube of Diplosoma. Dr. C. B. Davenport, Harvard College, The development of the cerata of Eolis. Dr. H. B. Ward, University of Michigan, The host of Nectonema. Dr. C. O. Whitman, University of Chicago, The metamerism of Clepsine. Dr. W. B. Scott, Princeton College, The evolution of the premolars. Dr. H. A. Ayers, of the Lake Laboratory, Milwaukee, The ending of the auditory nerves in the hair-cells. Dr. E. A. Andrews, Johns Hopkins University, Notice of a new sort of Amphioxus. Professor A. E. Verrill, Yale College, Some New forms of Nemerteans. Dr. T. H. Morgan, Bryn Mawr College, Preliminary note on Balanoglossus. Professor B. Sharp, Academy of Natural Sciences, Philadelphia, Joint formation among the Invertebrata. Professor W. A. Locy, Lake Forest University, The formation of the medullary grooves, and some other features of embryonic development in the Elasmobranchs.

The following gentlemen were elected officers for the current year: President, Dr. C. O. Whitman, University of Chicago; Vice-President, Dr. E. B. Wilson, Columbia College; Sec'y-Treas., Dr. J. Playfair McMurrich, University of Cincinnati. Members of the Executive Committee elected from the Society-at-large: Dr. T. H. Morgan, Bryn Mawr College; Dr. C. B. Davenport, Harvard College.

Association of American Anatomists.—Fifth annual session, Tuesday to Thursday, December 27 to 29, 1892, at Princeton, N. J. The officers for the year 1891-1892 were—President, Harrison Allen, M. D., Philadelphia; First Vice-President, Charles Heitzman, M. D., New York City; Second Vice-President, Theodore N. Gill, M. D., Washington, D. C.; Secretary and Treasurer, D. S. Lamb, M. D., Washington, D. C. Executive Committee: Thomas Dwight, M. D., Harvard University; E. C. Spitzka, M. D., New York City; Dr. F. H. Gerrish, Portland, Me., the President and Secretary, ex-officio. Committee on Anatomical Nomenclature: Harrison Allen, M. D., Philadelphia; Frank Baker, M. D., Washington; Thomas Dwight, M. D.. Harvard University; Thomas B. Stowell, Ph. D., Potsdam, N. Y.; Burt G. Wilder, M. D., Cornell University, Secretary. Delegate to American Congress of Physicians and Surgeons, F. J. Shepherd, M. D., Montreal, Canada. Alternate, R. W. Shufeldt, M. D., Washington, D. C.

Tuesday, December 27, the following business was transacted: 1, Opening of the session by the President; 2, Report of the Executive Committee; 3, Report of the Secretary and Treasurer; 4, Election of new members; 5, Report of the Committee on Anatomical Nomenclature; 6, amendment to Constitution, abolishing dues and substituting assessments; 7, Miscellaneous business.

Then followed the address of the President, Dr. Harrison Allen.

The following papers were read: 1. History of the development of bone tissue. Illustrated by microscopic slides. Dr. Carl Heitzmann, New York City; discussed by Professors Macloskie and Libbey. 2. Crania of the Cetacea (15 minutes), with specimens, Dr. Harrison Allen, University of Pennsylvania. 3. The human lower jaw (10 minutes), with specimens, Dr. Allen. The second and third discussed by Dr. Herrick and Professor Macloskie. 4. An anomalous human sternum, Dr. C. S. Lamb, Washington, D. C. Discussed by Dr. Dwight. 5. Observations on the psoas parvus and pyramidalis. A study on variation, Dr. Thomas Dwight, Harvard University. 6.

Significance of percentages in reversions in human anatomy, Professor H. F. Osborn, Columbia College, New York. Discussed by Professor Cope and Drs. Dwight and Lamb. 7. Series of thirty-five natural-size photographs of sections of human brain, with brief remarks, Dr. I. S. Haynes, University of New York. 8. Histogenesis in the brain, and its bearings on development and decline, Professor C. L. Herrick, University of Chicago. Discussed by Drs. Heitzmann and Piersol. 9. The metapore or foramen of Magendie, with photographs, Professor G. B. Wilder, Cornell University. Read by Mr. Clark. 10. Neuromerism and the cranial nerves of Ophidia, Professor Herrick. 11. The insula of the pig, with specimens, Tracy E. Clark, B. S., Clinton Liberal Institute, Fort Plain, N. Y. Discussed by Drs. Allen, Dwight and Spitzka. 12. The posterior surface of the liver; described by Vesalius; Dr. F. H. Gerrish, Bowdoin College, Maine. Discussed by Drs. Dwight, Heitzmann and Allen. 13. Embryos of bats, (with specimens), Dr. Allen. Discussed by Professors Cope and Minot. 14. Meckel's diverticulum, Dr. D. S. Lamb, Army Medical Museum, Washington. Discussed by Drs. Minot and Dwight. 15. Delimitation of abdominal regions, Dr. E. A. Balloch, Howard University, Washington. Read by the Secretary. 16. The need of agreement in the limits of the abdominal regions, Dr. Gerrish. Discussion of the last two papers together, by Dwight, Piersol, Kemp, Heitzmann and Lamb. 17. Physical characters of the Kootenay Indians, Mr. Alex. F. Chamberlain, Clark University, Worcester, Mass. 18. Discovery of an ossified thyroid cartilage, and a supposed rudimentary clavicle in an artiodactyl, with the specimen; Professor W. B. Scott, Princton, N. J. Discussed by Professor Cope and Dr. Allen. 19. Notes on diagrams of the spinal cord, Dr. J. T. Duncan, Toronto, Can. 20. Duration of motion of human spermatozoa, Dr. Geo. Piersol, University of Penna. Discussed by Drs. Spitzka and Heitzmann. 21. The innervation of the organ of Corti, Dr. Howard Ayers, Lake Laboratory, Milwaukee, Wis. Microscopical slides, with remarks.

New York Academy of Sciences.—Biological Section, Jan. 9.—The following papers were presented:—A. A. Julien, Suggestions in Microscopical Technique, including (*a*) a carrier of cover impressions (mycoderm blood) utilizing as clamps a coil of brass wire mounted in a phial. The same device with a platinum coil serves as a convenient staining phial for cover glass preparations; (*b*) a suggested medium for mounting delicately contractile protoplasmic objects; (*c*) devices for avoiding inclusion of air bubbles in mounts; (*d*) balsam-paraffin as a ring varnish.

O. S. Strong: On the components of cranial nerves of Amphibia. In the seventh a dorsal root was shown to pass off into branches representing ophthalmicus superficialis, facialis and buccalis of fishes, and innervating the lateral sense organs of the head. In vagus, a root of similar internal origin passes into the R. laterales, innervating the lateral sense organs of the body. Another component of the facialis is the fasciculus communis of fishes. This passes off into the palatinus and mandibularis internus, innervating the mucous epithelium of the oral cavity; while in the glosso-pharyngeus and vagus, similar components divided from this fasciculus innervate in like manner portions of the alimentary canal and its appendages. The relation of the results to segmentation of head was discussed.

N. L. Britton: A Review of the N. A. species of *Lespedeza*, with comments on the eleven native species, shown to be divisible into two groups, (*a*) those producing both petalous and apetalous flowers, and (*b*) those in which no petalous flowers are developed. Of the two naturalized species, one in S. E. part of U. S., *L. striata* (Thunb.) H. and A., is a native of E. Asia, appearing (about 1845) in Georgia.

BASHFORD DEAN, *Rec. Secy. of Section.*

Proceedings of the New Mexico Society for the Advancement of Science.—Meeting of November 2, 1892, at La Cruçes.—(No. 1.) Professor Townsend read a paper entitled "A partial comparison of the insect fauna of the Grand Cañon with that of the San Francisco Mountain in Arizona." The paper discussed briefly the conditions which exert an influence on the vertical range of species, and then gave some exact data on the topographical features of the above region. Dr. Merriam's life-zones of the San Francisco Mountains were re-stated, and the following provisional zones were offered for the Grand Cañon (from top of south rim at Hance's, 7500 ft., to Colorado River, 2500 ft.):

Canadian or balsam fir zone (only on north or northeast exposure).

Neutral or pine zone (only on north or northeast exposure).

Piñon or cedar zone—6000 to 7500 ft. (top of south or southwest exposure).

Sub-desert zone—4500 to 6000 ft.

Gila zone—2500 to 4500 ft.

The insect fauna was considered in three sections—that peculiar to the cañon, that peculiar to the mountain, and that common to both. These divisions were compared with each other, and also with the fauna of the surrounding region. Specimens of insects were exhibited, belonging to these three divisions of the fauna, and many photographs and views of the cañon region were shown.

(No 2.) "Exhaustion and renewal of soils," by Professor Arthur Goss. He first described soils chemically, and told where they obtain their various constituents. He next divided the productive existence of a soil into three periods—1. The pioneer period. 2. The period when soiling crops are necessary. 3. The fertilizer period. The desired thing in fertilizers is the element or compound which has been taken from the soil. The best way to find this is not by chemical analysis of the soil, but by judicious experimentation.

(No. 3.) Professor C. T. Hagerty read a paper entitled "Computation of the Comparative strength of Insects and the Higher Animals." He proved conclusively that the higher animals are much stronger than insects in proportion to their size, and readily accounted for the apparent superior strength of the latter. In the course of his remarks he referred to a computation on the comparative strength of the honey-bee and horse, made by Miall and Denny in a work entitled "The Cockroach" (page 82, edition of 1886), and pointed out an error in their computation. They state that the relative muscular force of the horse is more than fourteen times as great in comparison with that of the bee as it would be if the muscles of both animals were similar in kind and the proportions of the two similar in all respects, and he showed that according to their own method of solution, it would be 3.08 instead of 14. Quite a number of specimens of the insect fauna of Grand Cañon and the San Francisco Mountains of Arizona were exhibited by Professor Townsend, besides some photographs taken during the trip.

Dec. 1, 1892.—(No. 1.) Professor Townsend read a paper entitled "Notes on the occurrence of the puma (*Felis concolor* L.) in Southern New Mexico." The animal was reported on good authority as tolerably common in the Organ Mountains, and still more so farther east on the Peñasco River in Lincoln County. It has killed colts in Soledad Cañon (Organ Mts.). Measurements of some large skins are given, one of more than eleven feet being vouched for on good authority.

(No. 2.) Notes on the Ferns of the Organ Mountains, by Professor E. O. Wooton, following the distribution zones of ferns as advanced by Dr. Underwood in "Our Native Ferns and Their Allies" (pages 61–65, edition of 1888), he enumerated the various species and genera which had been collected on several trips to the mountains without any idea of such paper in view. Whole number of Genera collected, 7;

whole number of Species collected, 16. He then noticed the general characteristics to be: rigid stems, thick leaves, deeply-seated veins, fronds either very hairy, chappy, granulated, or with very thick epidermis. All of which characteristics were taken as being simply different ways of protecting themselves from the intense dryness of the climate.

(No. 3.) "Notes on the Mound Builders," by Professor J. P. Owen, was a paper concerning what is known of that ancient race. The professor showed, in several different ways, the difference between this race and the North American Indian found in possession of this continent at its discovery. He told of the migrations of this pre-historic race from the south and west to the central and northern states, and their probable return to the sections from whence they came. He led us to believe that these ancient peoples might have been connected with our Pueblo Indians, and were connected with the Aztec tribes of Mexico.

International Congress of Zoology.—The second meeting was held at Moscow, August, 1892. The fellowing papers were read:—

General Questions Concerning Biology:—Reply to questions proposed by Professor L. Cosmovici: 1. On a definite division of the animal kingdom into "phyla." 2. Natural basis of a system of the type of worms. 3. Uniformity in the terminology of the secretory organs of worms, J. von Kennel.—Observations on some points in Zoological Nomenclature, Ch. Girard.—On the importation and hybridization of reptiles and amphibians, J. de Bedriaga.

Special questions Concerning Biology:—Note on *Parapagurus pilosimanus*, a Pagurid from the abyss of the Atlantic Ocean, A. Milne Edwards and E. L. Bouvier.—Note on the fauna of the Black Sea, P. N. Bontchinsky.—On a fresh-water Thuricola, F. Vejdovsky.—Essay on the Classification of Animal variations according to their causes, A. Brandt.—The fauna of the eastern part of the Baltic Sea, and the problems for the next investigations in that fauna, Gr. Kojevnikov.—Geographical Distribution of the carnivora, Ch. Grévée.—The European and Circum-Mediterranean vipers, J. de Bedriaga.—*Chalcides symonyi* Steind., and *Molge luschiani* Steind., J. de Bedriaga.—Notes on the nests of insects made of clay, H. von Ihéring.—The Cetaceans of the Black Sea, living and fossil, J. van Beneden.—On the geographical distribution of the Cladocera, T. Richard.—On the Monodontophrya, a new species of the Opalinidæ, Fr. Vejdovsky.

Histology and Embryology:—Contributions to the theory of the mesoderm and of metamerism, N. Cholodovski.—Note on the formation of the germ of the peripheral nervous system, A. Plitzine.—Note on the development of the endothelium of the heart in the amphibians, V. Roudnev.—On the development of *Chrysopa perla*, Mme. O. Tichomirova.—On the segmentation of the egg, and the formation of the blastoderm of the Pseudoscorpionidæ, Fr. Vejdovsky.—On an embryonic organ of the Pseudoscorpionidæ, Fr. Vejdovsky.—Contribution to the history of the parasites of the Hymenoptera, N. Koulaguine.—The use of embryological researches for classification, A. Tichomiroff.

Physiology and Physiological Chemistry:—On the phosphorescence of animals in the Black Sea, P. Khvorostansky.

Morphology and Comparative Anatomy:—What is meant by "the water vascular system, the segmental organs, the excretory organs, and the nephridia, L. Cosmovici.—Presence or absence of an excretory apparatus in the genital organs of the Metazoa, H. von Ihering.—Note on metameric signification of the cranial nerves, P. Mitrophanov.—Position of the Strepsipteridæ in the system according to the data of post-embryonic development and of anatomy, N. Nassonov.—On the excretory organs of terrestrial arthropods, A. O. Kovalevsky.—On the origin and ancestry of the Arthropods, particularly the tracheated arthropods, N. Zograf.

Boston Society of Natural History.—January 18, 1893.—The following paper was read: Report on a study of Glacial sand-plains in Eastern Massachusetts, illustrated by lantern slides, by Professor W. M. Davis and students in geological field-work in Harvard University.

SAMUEL HENSHAW, *Secretary.*

SCIENTIFIC NEWS.

Recent Deaths.—HENRY TIBBOTS STAINTON.—Word comes from England of the death of this eminent Lepidopterist on December 2d, 1892, in his 71st year. For the past fifty years he has been one of the most active British entomologists. During this period he has been president of the Entomological Society of London, secretary and vice-president of the Linnean Society, and secretary of the Ray Society. One of the founders of the *Etomological Monthly Magazine,* he continued on the editorial staff from its beginning until his death. From this magazine we learn that he has published more than twenty-five volumes on natural history, besides frequent contributions to entomological periodicals. He studied chiefly the Micro-Lepidoptera, and was best known as a student of the Tineina. Two of his associates on the *Monthly Magazine,* Messrs J. W. Douglas and R. McLachlan, write: "Naturally diffident and unobstrusive in society, he yet pursued the objects that interested him, with ardor and perseverance, and his liberality in the cause of the advancement of entomological studies in Britain, which was always dear to him, and his unstinted aid in the identification of species, are too well known to require eulogy. From the first he restricted his researches to Lepidoptera, but he had sympathy with the students of all orders of insects, and of natural history generally. Possessed of an ample fortune, he used his means freely to assist any cause or person that he deemed to be deserving . . . In 1871 he was instrumental in founding the Zoological Record Association, for the purpose of continuing the Zoological Record, which had been relinquished by Er. Van Voorst, and largely through his liberality this indispensable publication appeared regularly until 1886, when it was taken up by the Zoological Society of London."

FREDERICK AUGUSTUS GENTH.—The death of Frederick Augustus Genth occurred at his residence, No. 3937 Locust street, Philadelphia, and ended, at the age of seventy-three, the career of a chemist and mineralogist whose reputation was not confined to one hemisphere, but was co-extensive with the world of scientific investigation. Professor Genth was born in Waechtersbach, Hesse-Cassel, on May 17, 1820. After attending the Gymnasium, in Hanau, he studied at the University of Heidelberg, under Liebig; at Giessen, and finally under Bunsen, at

Marburg, where he received the degree of Ph. D. in 1846. For three years he acted as assistant to Professor Bunsen, and soon afterward came to the United States, where he has since resided.

In 1872 he was called to the chair of chemistry and mineralogy in the University of Pennsylvania, which place he held up to within a few years ago. He had also held the office of chemist to the Geological Survey of Pennsylvania, and also to the Board of Agriculture of this State. Professor Genth was a member of many scientific societies in the United States, and was elected in 1872 to membership to the National Academy of Sciences. He had no superior in this country as an analytical chemist, and he greatly enriched the literature of chemistry with his very many and careful analyses of minerals. His name is associated with the ammonia cobalt bases, which he discovered in 1846, and, in joint authorship with Dr. Wolcott Gibbs, he contributed to the "Smithsonian Contributions to Knowledge," a monograph on "Researches on the Ammonia Cobalt Bases" (Washington, 1856).

Professor Genth was the author of nearly one hundred separate papers on subjects in chemistry and mineralogy, and published *Tabellarische ubersicht der Uichtigsten Reactionen welche Basen in Salzen zeigen* (Marburg, 1845); also the same in relation to "Acids" (1845); his "Minerals of North Carolina," being appendix "C" of the "Report on the Geology of North Carolina" (Raleigh, 1875). He also was the author of "First and Second Preliminary Reports on the Mineralogy of Pennsylvania" (Harrisburg, 1875–6) and "Minerals and Mineral Localities of North Carolina" (Raleigh, 1881).

NIKOLAI IVANOVITCH KOKSHAROFF, the well-known Russian mineralogist, died at St. Petersburg, January 2, 1893. During his early years he lectured on geology and physical geography, but later on devoted himself to the description of Russian minerals of which he discovered, and described many new ones. His chief works are embodied in eleven large quarto volumes of Beiträge zur Mineralogie Russlands, illustrated with numerous plates. The twelfth volume was in type when he died. He was a member of the St. Petersburg Academy of Sciences, and many of the scientific bodies of Western Europe elected him corresponding or honorary member.

—The address delivered by Professor Virchow on his assumption of the office of Rector of the University of Berlin, has been issued by the

German publisher, August Hirschwald, of that city, under the title "Lernen und Forschen."

Unofficial information has been received by Professor G. Brown Goode, of the National Museum, and member of the United States Commission to the Madrid Exposition, that awards have been made to the following exhibitors from this country:—

Gold medals—Smithsonian Institution, Bureau of Ethnology, National Museum, University of Pennsylvania, William Ellery Curtis, of Washington; the Hemenway Expedition, Dr. J. Walter Fewkes, of Cambridge.

Silver Medals—United States Geological Survey, the Numismatic and Antiquarian Society of Philadelphia, the Philadelphia Academy of Natural Sciences, the Peabody Museum of Archeology, Cambridge; The United States Mint, the United States Navy, The Army Medical Museum, Dr. D. G. Brinton and Mr. Stewart Culin, of Philadelphia; Professor O. T. Mason, Professor Thomas Wilson, Mr. W. H. Holmes and Mr. Walter Hough, of Washington; Mrs. Zelia Nuttall, of Cambridge.

Bronze Medals—Fish Commission, Department of Agriculture; Indian School at Carlisle, Pa.; Sons of the American Revolution, Dr. James C. Welling and Mrs. Tillie E. Stevenson, of Washington; Dr. Cyrus Adler, of New York; Mr. Warren K. Moorehead, of Xenia, O.

The gold medals, it is understood, are very handsome, with an intrinsic value of $150 apiece. Final action by the jury is not known, and others may be honored.

At the annual meeting of Bowdoin College Alumni held at Boston, Jan. 25th, Professor Robinson of the chemical department of Bowdoin, announced that Mr. Edward F. Searles, whose wife, the widow of Mark Hopkins, left him millions, had promised to erect the finest and best equipped building for the study of the sciences that could be had in this country. He stated that Mr. Searles had placed no limit on the cost.

Dr. Osaun has been appointed Geologist on the Geological Survey of Texas, and will take charge at once of the petrographic work of the Survey. Dr. Osaun is well qualified for the position, having been for many years first assistant to Professor Rosenbusch, in Heidelberg, and, later, extraordinary professor of mineralogy and petrography in that University.

Dr. Karl Spruner von Merz, the author of "Historisch Geographischer Hand Atlas," died August 24th, 1892, at the age of 89. His great work, commenced in 1837, was not completed until 1852. Spruner was also the author of two school atlases of historical geography.

The University of Cape Town has been admitted to affiliation with the University of Cambridge. This is the second of the Colonial Universities thus affiliated, the other being that of New Zealand.

According to the Anatomischer Anzeiger, the Biological station at Plön, under the direction of Dr. Otto Zaccharias, has accomplished successful work during the past Summer. Of the species of animals occurring in the Lake of Plön, there have been determined 20 fishes, 40 crustacea, 69 worms, 14 mollusca, and 74 protozoa. Of greatest interest is the discovery in fresh water of many organisms that have hitherto been supposed to occur only in the sea; and among these more especially may be noted certain genera of diatoms, rhizopods and worms. An illustrated report on results is soon to be published.

—Dr. R. von Wetlstein has been appointed Professor of Botany in the University of Prague, Bohemia.

—Mr. E. E. Prince, M. A., Professor of Zoology in St. Munigo's College, Glasgow, has been appointed Commissioner and General Inspector of Fisheries in Canada.

The Indiana Academy of Sciences has issued its Proceedings for 1891, in the shape of a pamphlet of 176 pages. It contains not only the proceedings of that year, but also a list of all papers read before the Academy since its organization in 1885. The Academy has 121 active, 11 non-resident and 1 honorary members. Copies of the Proceedings may be had of the secretary, Amos W. Butler, Brookville, Indiana.

Professor Bohumil Shimek has gone to Nicaragua to collect in the interests of the State University of Iowa. He will pay especial attention to the invertebrata and the cryptogamous plants.

Bulletin No. 40, of the U. S. National Museum, contains the fourth of the bibliographies of American Naturalists, that of George N. Lawrence by L. S. Foster, 121 titles are enumerated. A good steel portrait accompanies the Bulletin.

New York, Feb. 3.—A broad smile illumined the folio face of Caliph, the hippopotamus at the Zoo this afternoon. In the tank adjoining his a baby had arrived at exactly 12.15 P. M., and Miss Murphy, his mate, was its happy mother. Director Smith and his keepers knew Tuesday that something was in the air, for Miss Murphy was restless and excited. She is a nervous animal at all times, but Thursday she paced her cage all day, and Thursday night did not lie down once. The warning came just in time, and a thick straw bedding was given her, and the partition separating her from Fatima was put up. The latter has the empty tank and the mother has the landing.

After the youngster came, Mr. Smith said the first thing it did was to walk about shaking its tiny ears and giving little grunts. Murphy followed wherever it went, and would allow no one to approach within the railing, and so he didn't attempt it. Caliph meanwhile found a peek-hole in the boards, and viewed his progeny with a great deal of interest. He refused to go into his tank, and last night slept within touch of the mother and baby.

The baby weighs about thirty pounds, being very small. Its color is pink—a salmon hue—and its legs are so short as to be almost imperceptible at first sight. It is lively and runs about a great deal, much to the mother's discomfort. It is a peculiarly shaped animal. It might be said that it has no shape at all. It is about eighteen inches long, has no tail, ears that can hardly be seen and mouth no larger than a pint cup. The mother guards it with a great deal of care. It is her third born. Four years ago one was born which weighed sixty-three pounds. It died. Fatima came next, having been born October 4, 1890. Murphy is 8 years old and cost $5000. She weighs between 3000 and 4000 pounds. Caliph was brought from the Cincinnati Zoo and cost $5000. He weighs 7000 pounds. To-night Murphy and her baby were doing nicely.—*Late paper.*

Table of Contents of the North American Review for February, 1893.—How to Revise the Tariff, by the Hon. Wm. M. Springer, Chairman of the Ways and Means Committee; Recollections of the Panama Canal Congress, Rear-Admiral Ammen, U. S. N.; Changes in the Church of England, The Dean of St. Paul's; Criminal Law in France, Madame Adam; Boons and Banes of Free Coinage, I. "In the Interest of Shylock," by the Hon. R. P. Bland, Chairman of the Committee on Free Coinage, Etc., II. A Warning to Savings Bank Depositors, by John Harsen Rhoades, President of the Greenwich Savings Bank, N. Y., III. A Depositor's Point of View, by a Depositor in a Savings Bank; Wild Stag Hunting in Devon and Somerset, The Countess of Malmesbury; Government Aid to the Nicaragua Canal, Senator John T. Morgan; Shall Our Laws be Codified? Frederic R. Coudert; Needed Reforms in the Army, General John Gibbon, U. S. A; Why Immigration Should Not be Suspended, Senator H. C. Hansbrough; The Hope of a Home, Erastus Wiman; Europe at the World's Fair, I. The British Section, by Sir Henry Trueman Wood, Secretary to the British Commission, II. The French Section, by Theodore Stanton, Commissioner Resident in Paris; Notes and Comments, Mistakes—but Not of Moses, Charles W. Trickett; Science and the Woman's Question, Lydia Lvovna Pimenoff; From Renan's Point of View, Arthur Reed Kimball; The American Common Schools, Rev. James A. King.

TO CONTRIBUTORS.

Written contributions must be sent to Editors only. Proof must be sent to publishers only.

Orders for Separata must be written on copy as orders on Separate pieces of paper may be lost.

To Exchanges, Publishers, Etc.

Books, papers and periodicals sent in Exchange or for review must be sent to Editors.

☞SPECIAL NOTICE

FROM THE PUBLISHERS.

Owing to the excess of matter in this issue, the publication was somewhat delayed. We shall always aim to get out each issue promptly on the first of each month, but our editors and authors being so wide-spread we are often delayed a few days in the return of the proofs of articles sent them for revision. With this explanation

we are, truly yours,

BINDER & KELLY.

APR 10 1893

THE

AMERICAN NATURALIST

Vol. XXVII. April, 1893. 316

THE GENEALOGY OF MAN.

By E. D. Cope.

The ancestry of man is a question to be solved by paleontology. Within the last twenty years, important progress has been made in our knowledge of the phylogeny of the mammalia, and some points have been gained which throw considerable light on the more immediate predecessors of man. These additions to knowledge have been made in the fields of both simian and human paleontology, and they have naturally received attention from archeologists as well as paleontologists. The question must be approached from the side of anatomy primarily, although aid from any other source is essential. Philology can, of course, give us no assistance, since the first man can have left no trace of his language. It is a fact that in some quarters, archeologists who are not anatomists, seem to underrate the value of anatomy in the premises, and are inclined to dispute the existence of men of very primitive or simian physical characteristics. But archeology, apart from anatomy, is a poor guide in the field of human ancestry.

Nothing is better known than that some races of men present a larger proportion of simian characteristics than others. Thus these approximations are fewest in the Indo-European race, and are rather more evident in the Mongolian. In the Polynesian, Negro, and Bushmen, they are most numerous, and in about equal but differently distributed proportions. Confining our attention to the skeleton, it is known that almost every part of it is the seat of variations of greater or less significance.

Much importance attaches to the dentition. Many years ago, Owen[1] called attention to the fact that in the dark races the roots of the last superior molar are distinct from each other, while in the Indo-Europeans they are known to be more or less fused together. These now well-known characteristics of human dentition constitute one of the examples of transition from a simian to a human type. I have pointed out a corresponding modification in the structure of the crown of the superior true molars, viz: the transition from a quadritubercular to a tritubercular structure in passing from the lower to the higher races. As this point has some interesting implications in the earlier phylogeny of man, and as its value has been disputed, I give it a little attention.

The facts of the case are as follows: I have demonstrated[2] the fact that all forms of dentition exhibited by the Eutherian Mammals have been derived from a primitive tritubercular type. Professor Osborn says that he expects to be able to do the same for the Multituberculate (? Prototherian) dentition. I have also shown that man exhibits a tendency to revert from his primitive quadritubercular molar to this tritubercular type.[3] These facts are now common knowledge among paleontologists, although Dr. Brinton states in one of his late works that the latter proposition has been "refuted" by Dr. Harrison Allen and Professor Virchow. As to the significance of these facts, I have expressed the view that this acquisition of a tritubercular molar is a reversion to the lemurine type. This conclusion is necessary because the lemurs are the last of the families in the line of the ancestry of man which present this dentition. The monkeys and anthropoid apes are all quadritubercular, except a few limited collateral branches of the former, which still retain the lemurine type. There are also a few collateral types of lemurs which have acquired one or more quadritubercular molars, but they are not typical. In many tritubercular mammals, a precocious form or two can be found, which has acquired the fourth tubercle. But the further back we go in time, the fewer they become, until, in the Puerco fauna, of eighty-two species of Eutherian Mammals, but four have true quadritubercular superior molars.

---

[1] Odontography, 1840–5, p. 454.

[2] Proceeds. Amer. Philosoph. Soc., Dec. 1883; Origin of the Fittest, 1887, pp. 245, 347, 359.

[3] Amer. Journal of Morphology, II, 1888, p. 7.

I take this opportunity of saying, however, that reversion is not necessarily a result of heredity. It may be simply a retrogression on a line of advance already laid down. What influence lemurine heredity may have had in the case of man, it is not easy to know. But it must be borne in mind that various forms of degeneracy of molar teeth are possible other than the resumption of the tritubercular type, yet the normal reduction generally presented, is just this lemurine and primitive Eutherian condition. The simplicity of the elements involved, has something, but not everything, to do with this reversion.

Dr. Paul Topinard has made an investigation[4] of the characters of the crowns of the molars in man, and has reached general conclusions identical with my own. He remarks (p. 665), "It is demonstrated, in conclusion, that the teeth of man are, at present, in process of transformation, and that in some future which is remote, the inferior molars shall certainly be quadricuspid, and the superior molars tricuspid. It will be curious to have the statistics as to prehistoric man; unfortunately, their crania are rare, and their molars generally much worn." In the details of his examination, there are some divergencies from my results. Thus he finds the quadritubercular second and third superior molar relatively of more frequent occurrence in Europeans than I did. But the absence of Europeo-Americans from his tables reduces the percentage of tritubercularsin the Indo-Europeans. He makes no report of Esquimaux. Had he observed this type, he would have found a higher per cent. of tritubercular upper molars than in any race that he has recorded. He confirms my conclusion as to the high percentage of quadritubercular superior molars in the Malays, Polynesians and Melanesians.

---

[4] L'Anthropologie, 1892, p. 641 (Nov., Dec.).

The relation of this fact to phylogeny is to confirm Hæckel's hypothesis of the lemurine ancestry of man. I have advanced the further hypothesis that the Anthropomorpha (which include man and the anthropoid apes) have been derived directly from the lemurs, without passing through the monkeys proper. This close association of man with the apes, is based on various considerations. One of them is that the skeleton of the anthropoid apes more nearly resembles that of man in the most important respects than it does that of the monkeys. This is especially true of the vertebral column, where the anapophyses are wanting in the Anthropomorpha (insignificant rudiments remaining on one or two vertebræ, as pointed out by Mivart), while they are well developed in the monkeys and lemurs. The frequent presence of the tritubercular molar in man disposes of the superior claim of the monkeys over the lemurs to the position of ancestor. Another significant fact pointing in the same direction is the existence of large-brained lemurs with a very anthropoid dentition (Anaptomorphidae) in our Eocene beds. This resemblance is very remarkable, much exceeding that lately observed by Ameghino in certain extinct forms of monkeys in Patagonia, which appear to be ancestors of the existing South American monkeys (Cebidae), and possibly of the Old World monkeys also. The superior molars of Anaptomorphus are tritubercular, while the premolars, canines, and incisors are essentially anthropomorphous, and rather human than simian. Anaptomorphus is probably at the same time the ancestor of the Malaysian lemurine genus Tarsius, and M. Topinard remarks that Tarsius has as good claims to be regarded as ancestral to Homo as Anaptomorphus. But M. Topinard must be aware that in the existing genus the character of the canine and incisive dentition is very unlike that of the Anaptomorphus and Homo. It is specialized in a different direction. The dentition of Anaptomorphus being so generalized as compared with Tarsius, I suspect that its skeleton will be found to present corresponding characters. Of course, if it be found hereafter to have the foot structure of Tarsius (which I do not anticipate), it must be removed from the line of ancestry of the Anthropomorpha.

It must be further observed that the ancestral line of the Anthropomorpha cannot be traced through any existing type of Lemuridae, but through the extinct forms of the Eocene period.[5] This is on account of the peculiar specialization of the inferior canines, which are incisor-like, and because of the peculiar character of the incisors themselves, in the modern lemurs in the restricted sense. But we have numerous lemurine types of the Eocene of both America and Europe which satisfy the conditions exactly, so far as the dentition is concerned. These are mostly referable to the family Adapidae.

Unfortunately, we do not know the entire skeletons of these Eocene lemurs, but as far as we have them (genera Tomitherium and Adapis), they are monkey-like. But we have what is almost as useful, the skeleton of their Eocene and Puerco ancestors, the Condylarthra. I long since pointed out that the latter order (not the genus Phenacodus, as Lydekker has represented me as saying), must be the ancestors of the lemurs, basing my views expressly on the general structure of Phenacodus, Periptychus and Meniscotherium. The structure of the ungual phalanges of Periptychus is very significant, and even more so is that in Meniscotherium, as recently shown by Marsh, who adopts (without credit) my hypothesis of lemurine affinities of the Condylarthra (which he renames the Mesodactyla). From Condylarthra back to Creodonta is an easy transition, and I have always assumed that the Creodonta were derived from generalized Polyprotodont Marsupialia. This view has been entirely confirmed by the recent discoveries of Ameghino in Patagonia, where he has found forms whose remains may be referred with equal propriety to the one group or the other. M. Topinard has been rather hasty in reaching the marsupial ancestry in supposing that Phenacodus belongs to that order. All the evidence shows that Phenacodus is a generalized ungulate placental.

To return to the more immediate ancestry of man. M. Topinard believes that I hold the opinion that the Hominidae descended directly from the lemurs without the intervention of the Simiidae. I have, on the contrary, expressed[6], and now maintain as a working hypothesis, that the Anthropomorpha were descended from the Eocene Lemuroids. In my system[7] the Anthropomorpha includes the two families Hominidae and Simiidae. The sole difference between these families is seen in the structure of the posterior foot; the Simiidae having the hallux opposable, while in the Hominidae the hallux is not opposable. This is not a strong character, since it depends on a slight difference in the form of the entocuneiform bone. In some vertebrates, as the tree frogs, the same and similar characters (genus Phyllomedusa) are not regarded as of family value. It is then highly probable that Homo is descended from some form of the Anthropomorpha now extinct, and probably unknown at present, although we do not yet know all the characters of some extinct supposed Simiidae, of which fragments only remain to us. It cannot now be determined whether man and the Simiidae were both descended from a genus with opposable hallux, or without opposable hallux, or whether from a genus presenting an intermediate character in this respect. This genus was, in any case, distinct from either of the two existing genera of Simiidae, Simia and Hylobates, since these present varied combinations of anthropoid resemblances and differences, of generic and specific value.

---

[5] On the Primitive Types of the Orders of the Mammalia Educabilia, 1873, p. 8.

Professor Virchow has recently[8] thrown down the guage to the evolutionary anthropologists by asserting that "scientific anthropology begins with living races," adding "that the first step in the construction of the doctrine of transformism will be the explanation of the way the human races have been formed," etc. These two assertions are inconsistent, since the only way of solving the latter problem will be by the discovery of the ancestral races, which are extinct. The ad captandum remarks of the learned professor as to deriving an Aryan from a Negro, etc., remind one of the criticisms directed at the doctrine of evolution when it was first presented to the public, as to a horse never producing a cow, etc. It is well known to Professor Virchow that human races present greater or less approximations to the simian type in various respects. Such are the flat coössified nasal bones of the Bushmen; the quadritubercular molars of the Polynesians; the flat ilia and prognathous jaws of the Negro; the flat shin-bones of various races; the divergent hallux of some aborigines of farther India, etc. But that no nearer approximation to the simian type than these has been discovered in any race will surprise most students of the subject. Professor Virchow does not satisfactorily explain the significance of the Cannstadt and Neanderthal skulls, and in his address he ignores the important and well authenticated discovery of the man and woman of Spy. To these ancient people I will now devote some space, describing more especially the dentition so far as it has been preserved.

---

[6] American Naturalist, 1885, p. 467.

[7] Origin of the Fittest, 1887, p. 346, from American Naturalist, 1885, p. 346, where the classification of the Taxeopoda should be in a foot-note; loc. cit., 1889, October.

[8] Popular Science Monthly, Jan. 1893, p. 373, translated.

What had been long suspected is now established, through the discovery and descriptions of MM. Lohest and Fraipont of

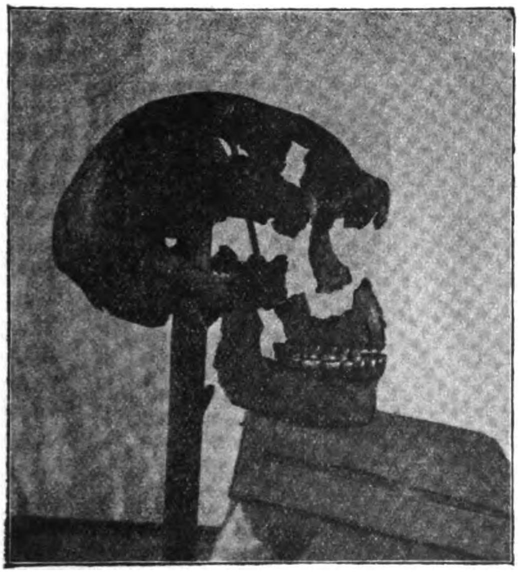


FIG. 1—SKULL OF THE MAN OF SPY. From Professor G. F. Wright's Man and the Glacial Period. From a photograph.

Liége, viz.: that there dwelt in Europe during paleolithic times, a race of men which possessed a greater number of simioid characteristics than any which has been discovered elsewhere. The important discovery in the grotto of Spy, of two skeletons, almost complete, served to unify knowledge of this race, which had previously rested on isolated fragments only. These skeletons proved what had been previously only surmised, that the skeleton of Neanderthal, the lower jaw of Naulette, and the crania of Cannstadt, belong to one and the same race. The simian characters of these parts of the skeleton are well known. These are the enormous superciliary ridges and glabella; the retreating frontal region; the thickness of the cranial wall; the massive mandibular ramus with rudimentary chin, and the large size of the posterior molars. MM. Fraipont and Lohest have added other very important characters to these, viz: the tibia shorter than in any other known human race; the sigmoid flexure of the femur; the divergent curvature of the bones of the fore-arm, and a very peculiar form of the posterior face of the mandibular symphysis. Of these characters MM. Fraipont and Lohest write as follows:[9]

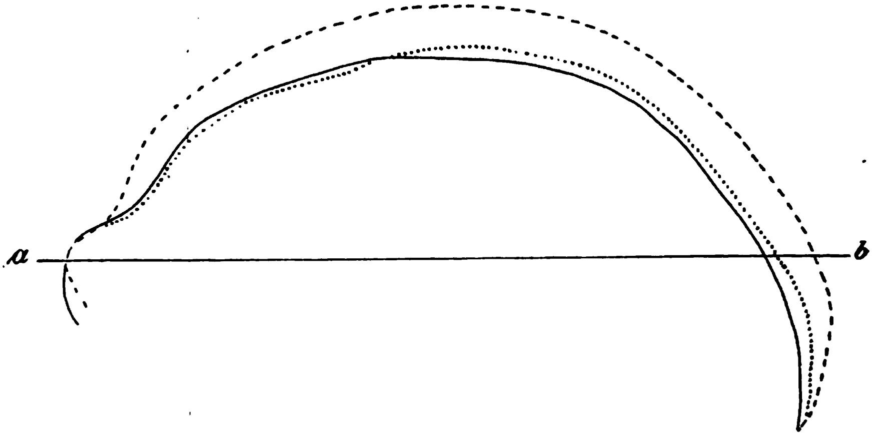


FIG. 2.—Outlines of calvaria of the Neanderthal man in solid line; of the Spy man no. 1 in dots; and of the Spy man No. 2 in broken line. From Fraipont and Lohest.

I.—The prominent superciliary crests, which are characteristic of the Cannstadt race. No existing race presents such a development, neither the Papuans, Australians, nor Negroes of any race. But we find the superciliary crests and underlying sinuses identical in adult female orangs and chimpanzees and young male gorillas. In the female chimpanzees the crests are almost inferior in size to those of the man of Spy.

---

[9] Archives Belges de Biologie, VII, 1886, p. 731, Gand.

II.—The retreating forehead of the two crania of Spy, is not found in any existing human race, while it is typical of that of Cannstadt. It is characteristic of female orangs and gorillas and of the young males of both species, and of adult males and female chimpanzees. It appears in existing men in rare and isolated cases.

III.—The prominent transverse superior semicircular crest of the occipital bone is found in existing races among the Fellahs of Africa and the Nigritos. It is characteristic of the Cannstadt skulls, and presents exactly the same characters as the young male and female orang and gorilla, and young male and adult female of the chimpanzee.

IV.—No human race presents the characters of the lower jaw exhibited by those of Spy, Naulette and Shipka. In this part of their osteology the anthropoids depart widely from man, the most conspicuous point in the latter being the presence of a chin. Accordingly, the angle formed by the anterior face of

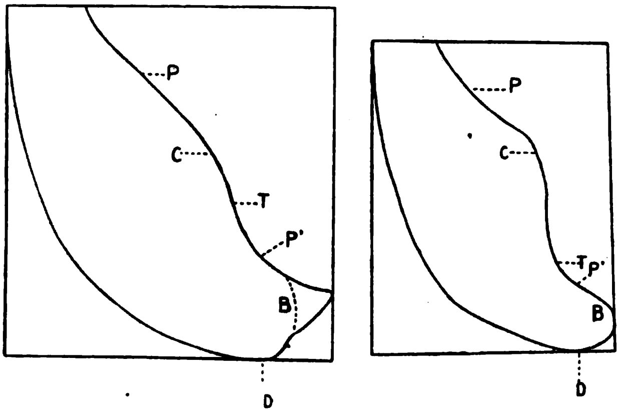


FIG. 3. FIG. 4.

Vertical sections of symphysis mandibuli of gorilla (Fig. 3), and orang (Fig. 4). From Fraipont and Lohest.

the symphysis with the inferior border of the horizontal ramus, is less than a right angle in man, and much more than a right angle in the anthropoids. According to Topinard, this angle in fifteen Parisians is 71°.4; in fifteen African Negroes, 82°.2; in fifteen Neocaledonians, 83°.9; in the jaw of Naulette, 94°. In the best preserved jaw of Spy, the angle is 107°, if measured from the inferior symphysial border, or 90° if measured from the inferior border of the ramus. There is no chin in the jaw of the Cannstadt race, and the large angle approaches without nearly equaling that of the anthropoids. But the posterior face of the symphysis presents the most remarkable peculiarity. In the symphysis of the apes (Figs. 3, 4, 5) the posterior border is a continuous slope from the alveolar border to the inferior margin, interrupted by a slight concavity below the middle. In the human jaw this line slopes backward to near the middle, where are situated the small tuberosities for the insertion of the genio-glossal muscles. (B in the accompanying figures.) The surface then slopes rapidly forward to pass into the narrow inferior border of the chin (Figs. 8, 9). In the jaws Naulette and Spy, the structure is exactly intermediate between the two, and quite different from both. It commences above with a posterior slope similar to that of the apes, exhibiting what is called by Topinard, internal prognathism, as it appears in the lower human races. The surface then descends abruptly, form-

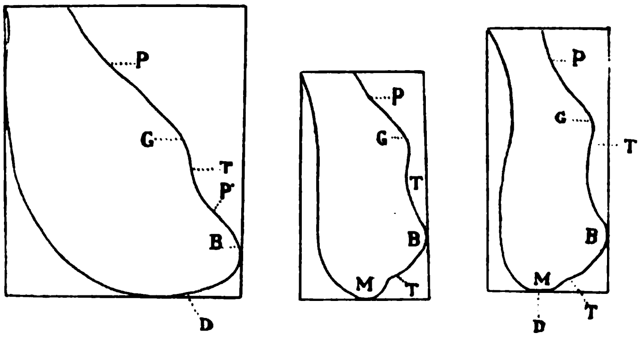


FIG. 5. FIG. 6. FIG. 7.

Vertical sections of symphysis mandibuli of chimpanzee (Fig. 5); of Spy man No. 1 (Fig. 6), and Spy man No. 2. (Fig. 7). From Fraipont and Lohest.

ing a vertical concavity, which is bounded a considerable distance below by another protuberance, the insertion of the genio-glossal muscles. This concavity is not present in the human symphysis, while it is less developed in the simian. The surface then slopes forward, as in the human symphysis, but this portion is shorter than in human jaws generally. It is represented by a convex face in the simian jaw. This character taken in connection with the others cited, goes a long way toward justifying the separation of the Cannstadt race as a distant species, as has been done by some author under the name of *Homo neanderthalensis* (Figs. 6, 7).

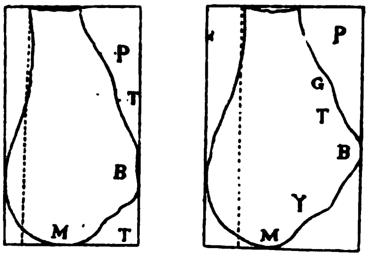


FIG. 8. FIG. 9.

Sections of symphysis mandibuli of modern Liegois (Fig. 8), and of an ancient Parisian (Fig. 9). From Fraipont and Lohest.

V.—The curvature of the ulna and radius, which produces a wide interosseous space, is not found in any human race, but is common to the apes. On the contrary, the shortness of these bones is entirely human.

VI.—The anterior convexity of the femur, with its round section, is only found among living races among the Nigritos of the Philippine Islands. It is seen in a less degree in femora of neolithic men, and occasional instances are seen among existing Europeans. It is the normal condition in the apes.

VII.—The tibia is shorter in its relation to the femur than in any human race, and is more robust than in most of them. This character, with the oval section, while not identical with what is seen in the apes, forms an approximation to it.

VIII.—The condyles of the femur are not only wider than in human races generally, but they are more produced posteriorly. The portion habitually resting on the head of the tibia is so far posterior as to throw the femur backward when in place. This requires that in order to maintain equilibrium, the head and body must have been thrown forward. This relation of the femur and tibia is what we find in the apes, and it is highly probable that the man of Spy presented a somewhat similar figure when walking. That is, the knees were bent and the body thrown forward. In the best preserved leg, the knee was also slightly bent inward. The femur had, however, the superior length generally characteristic of man, though this, it is well known, is a variable character.

MM. Fraipont and Lohest have pointed out the general characters of the dentition of the man of Spy. They show that the molars increase in size posteriorly to the same extent that they do in the apes, which is the reverse of what is usual in man, where they diminish posteriorly, or, in a few lower races (Australians, etc.), remain equal. They show that the superior molars are all quadritubercular, and that the internal root is distinct in all of them. Through the kindness of M. Lohest, I received casts and photographs of these teeth, and I give here figures the former (Plate IX), which are more satisfactory than those in the memoir from which I have already quoted so fully, where, indeed, the grinding faces are not represented at all. I also make some remarks which they suggest, on some details not noticed by MM. Fraipont and Lohest.

The casts of the teeth of the man are those of P. m. $\frac{2}{}$ and M. $\frac{1\ 2}{}$ of one side, and of M. $\frac{1\ 2\ 3}{}$ of the other side. Those of the woman are alveoli of I. $\frac{2}{}$ and C. $\frac{1}{}$, and the entire teeth of P. m. $\frac{1\ 2}{}$ and M. $\frac{1\ 2\ 3}{}$ all of one, the right, side. The crowns of the man's teeth are moderately worn, so that their composition can be studied, while those of the woman are more worn, so that the composition is somewhat obscure. Comprehensively, it may be stated that the true molars are fully quadritubercular, as in the lowest known races of men, and that the hypocone is in the anterior molars, as large as the protocone, while it is always smaller in man when present. In the female the last superior molar has a well-developed internal root, which diverges widely from the posterior external, even more widely than in a chimpanzee in my possession. This arrangement is imian than that seen in Australian and Maori denti- collection. The last molar of the male is stated ilar structure, but the roots cannot be clearly seen in cast. These two characters then place the man of lowest category, just as would be naturally expected nce of the other simian characters already referred ntition is inferior to that of the neolithic man of here the last molar at least is tritubercular.

her peculiarities of these dental series may be now In the female dentition, where alone the canine ain, the size of the latter tooth and that of the large, relatively, to that of the true molars. The ot remarkably large, but exceeded by a little, that seen in Polynesians and Australians, where it is ong human races. The premolars exceed a little ions seen in the same races, approximating but not ing the relative dimensions seen in the chimpanzee. re relatively more robust in the transverse direction man dentitions generally. The first and second he female are of equal transverse diameters, while is a little wider transversely and quite as wide riorly. This large dimension for the third molar ything I have observed in human dentitions except of a single Australian in my collection, surpassing t of the chimpanzee, and reminding one of some of s (Hylobates), where, however, the crown is subcir- tline. In the male the transverse diameter of the r is a little smaller than that of the other molars, th is larger than is usual in man, and equals in its that of the chimpanzee.

arity which is pronounced in the male, and observ- first molar only of the female, is the prolonged pos- exity of the grinding surface. This is unlike any- ve seen in human molars, and resembles the char- e orang[11] more than that of any other quadrumane me. This appearance is increased by a contrac-

cit., p. 17.

ontography, p. 444.

tion of the grinding surface posteriorly, by the convergence of the internal and external borders, a peculiarity apparently unique to the man of Spy. The forward overlap of inferior molars on the superior is much greater than usual in the male. This contraction of the posterior part of the external border is equally marked in the female, but the posterior border is not so convex. It results from the peculiar form of the external borders of the crowns of the true molars in both sexes, that they form an echelon arrangement. This does not seem to be an adaptation to an oblique outline of the maxillary arch, which is broadly rounded as in the Australians and Polynesians.

Summarizing the above observations, I would say that in the quadritubercular molars, with distinct and divergent roots, the man of Spy takes the lowest position among the subspecies of man. Second, that in the relative proportions of the premolars and molars with each other and among themselves, he possesses some characters lower than any of the known races of man, and approximates near to the apes. Third, that in the echelon arrangement of the external wall of the molars, he presents a peculiarity more strongly pronounced than either man or apes, and whose true significance can not now be determined. It occurs in the abnormal V-shaped maxillary arch of existing men, but the arch in the man of Spy has not this character, but is fully rounded, and as it occurs in both sexes, it is not probably an abnormality.

In conclusion, it may be observed that we have in the *Homo neanderthalensis* a greater number of simian characteristics than exist in any of the known races of the *Homo sapiens*, although, so far as known, he belongs to the genus Homo. The posterior foot, so far as preserved, indicates this to be the case. The foot-character, which distinguishes the genera Homo and and Simia still remains. There is still, to use the language of Fraipont and Lohest, "an abyss" between the man of Spy and the highest ape; though, from a zoological point of view, it is not a wide one.

The flints which were discovered in the stratum of cave deposit containing the human remains, are of the paleolithic type known as Mousterien in France, which are of later origin than the Chelléen or older paleolithic. The older paleolithic man is not yet known. It is interesting to observe that these flints (Mousterien) are of the same form as the obsidian implements which I collected at Fossil Lake, in Oregon, with the bones of extinct llamas, horses, elephants, sloth, etc. The animals which accompanied the man of Spy are, *Cœlodonta antiquitatis* (wooly rhinoceros), *Equus caballus*, *Cervus elaphus*, *Cervus tarandus*, *Bos primigenius*, *Elephas primigenius*, *Ursus spelæus*, *Meles taxus*, *Hyaena spelæa*; five extinct and four existing species.

As the evidence now stands, the most primitive and simian of human races inhabited Europe. No trace of the *Homo neanderthalensis* has been found in any other region of the earth. As, however, paleolithic implements are found in all continents, we may anticipate that this or some similar species of man will be discovered there also. An equally probable conclusion is that, taking into consideration the characters of the Neolithic man, the Europeans originated in Europe, and that some of us are the direct descendants of the *Homo neanderthalensis*.

EXPLANATION OF PLATE.

Dentition of the man and woman of Spy, natural size; taken from casts.

Fig. 1. Superior molars of the man from below.

Fig. 2. Do. of the woman from below; 2a do. last posterior molar from behind.

Fig. 3. Maori, last superior molar from behind.

Fig. 4. Do. of Tahitian from below; *a* do. from behind, showing fused roots.

Fig. 5. Superior dentition of a Fan from West Africa, from the collection of the University of Pennsylvania; *a* last superior molar.

Fig. 6. Inferior dentition of Fan of Fig. 5.

Fig. 7. Esquimaux, superior molars; from cranium in Army Med. Museum, Washington, D. C.

THE PROBABLE PHYSIOGNOMY OF THE CRETACEOUS PLANT POPULATION.

BY CONWAY MACMILLAN.

The sudden appearance of metaspermic plants in the rocks of the Cretaceous period has occasioned much discussion, and has always proved to be a *crux* to the writers on evolutional philosophy. Even in the latest work of authority on general evolutionary topics—*Darwin, and after Darwin*, by Romanes, the old and vague statements—concerning "probable breaks in the records," and possible remarkable accelerations of what are usually very slow processes,—may be found again, and have the air of being all that can yet be said with much show of reason from the evolutional point of view. The various opponents of Darwinism, and of evolution in its broader sense, have ever appealed to the sudden emergence of Cretaceous metaspermic plants as an unanswerable argument against the different development-hypotheses. There is not space here even to cite the numerous works in which the unexplained and sudden appearance of Cretaceous metaspermic plants has been adduced in condemnation of the various evolutionary hypotheses. All students who have kept pace with the controversial biological literature of the last thirty years, will readily recall the important part that the Cretaceous plants have played in the anti-evolution polemic.

In view of what has been stated above, the intent of this paper will be recognized as a sufficiently ambitious one, when it is stated to be an effort to show two facts, as developed by the study of modern plant-formations and the evidence of the fossils; first, that the appearance of Cretaceous metaspermic plants is proved, *by the fossils*, not to have been sudden, but gradual, and consequently, in Cretaceous time, the general preponderance of plant-population was strongly coniferous, fern and cycadean; and second, that the conditions of Cretaceous time were such that the new and scattered metaspermic plants were placed under circumstances similar to those in which to-day variation is most rapid and plasticity is greatest for each species and even for every individual.

The attempt to show that the high preponderance of metaspermic remains in the Cretaceous rocks is a sufficient proof of the high preponderance of pines, cycads, ferns and club-mosses in the Cretaceous forests is paradoxical enough to excite grave suspicions of the method by which such a result is reached, but the writer hopes to show that the absurdity of the statement is solely a superficial one, and that it is really capable of a defence both from experiment, observation and legitimate deduction. I have already presented in my recent work on the plants of the Minnesota valley the skeleton of the argument,[1] but desire here to amplify and extend the discussion, somewhat, to more fully cover the ground. If the conclusions that I have drawn are legitimate, and my knowledge of the literature of the subject sufficient to uphold my belief that certain new laws are determined, both of plant-distribution to-day and paleontological interpretation, it will be clear that the argument is an important one, and should be examined for what it may prove to be worth.

In the first place let us examine some of the observed facts of plant-distribution to-day. It is apparent that while species themselves are generally limited in some more or less definite manner and occupy a more or less considerable area of the earth's crust, there are several degrees of aggregation in which species play a subordinate part. We note the coniferous forest as distinct from the hardwood forest, the prairie knoll from the prairie swale, the mountain-side herbage and shrubbery from the herbage and shrubbery of the valley. The presence of these different zonal groups at different attitudes and latitudes was first pointed out in the modern way, by von Humboldt.[2] Since his time, the various groups of species, conditioned in some definite manner and, under climatic influences, acquiring characteristic habits or habitats, have been studied somewhat in detail. The great works of DeCandolle[3], Grisebach[4], Engler[5], Drude[6], and the numerous special brochures of these and of many other writers on geographical botany, have pointed out with much distinctness the existence of plant-formations. These formations are of different degrees. In the United States there are, in the eastern portion, two very distinct formations that belong to the highest division—namely, the forest and the prairie. These two great formations, in the broadest sense, are scarcely anywhere in contact with each other, but are separated by what may be a very narrow strip of plants imperfectly developed in either forest or prairie. The region occupied by such a transitional strip of plants I have named in the work cited above, a *tension-line*. Wherever two formations of different sorts, such as hardwood forest and coniferous forest, meadow and hillside-grassland, or any other two, come together, there is such a tension-line developed along the line of contact.

---

[1] Metaspermæ of the Minnesota Valley, p. 602 (1892).

[2] Essai sur la Geographie des Plantes, suivi d'un Tableau Physique des Regions Equinoctiales.

De Distributione Geographica Plantarum, secundum cœli Temperium et altitudinem montium, Prolegomena.

The character of the tension-line between formations has received as yet very little study, and it is not possible to speak of it as exactly as one would wish. My own observations are confined to the tension-lines between forest and prairie in the Minnesota valley, a region of special study for the past two years. Certain interesting facts have been deduced. These may be noted as follows:

The plants of the tension-line consist of such species as are sparsely developed in the more central areas of the two adjacent formations, or in some cases of species very poorly developed in the solid parts of the two formations.

The number of individuals of the first group is generally greater over a given area along the tension-line than in the solid portions of the formations.

[3] Gèographie Botanique Raisonnèe, on exposition des Faits Principaux et des Lois concernant la Distribution Geographique des Plantes de l'epoque actuelle. Tom. I, II (1855).

[4] La Vègètation du Globe, d'apres sa Disposition suivant les Climats, esquisse d'une Geographie Comparèe des Plantes, trad. par P. de Tchihatchef. Tom. I, II. (1877).

[5] Versuch einer Entwickelungsgeschichte der Pflanzenwelt, insbesondere der Florengebiete seit der Tertiärperiode. Th. I, II. (1879).

[6] Handbuch der Pflanzengeographie. (1890).

There is a tendency for plants of a higher phylogenetic type to accumulate in the tension-line area than characterizes either of the adjacent formations. Thus in the border of the wood and prairie one finds Asters, Helianthi, Solidagos, predominant over the lower Archichlamydeae or Monocotyledones.

There is a transition from typically prairie groups of grasses to the typical tension-line groups of species, and similarly from the typically forest groups of trees, in the hardwood belt.

The tension line is characterized by a greater comparative richness of species and luxuriance of individuals, in the matter of number, than the average of the adjacent formations.

The tension-line is not a fixed, but a moving line, and usually one formation or the other is in a condition of encroachment while its adjacent formation is in a condition of retreat.

The movement of the tension-line is felt some distance from the contact line of the two formations, so that, if forest is encroaching upon prairie, the characteristic composites of the tension-line are thrust out farther into the prairie.

From the interior regions of both adjacent formations plants "work out" into the tension-line area. Such plants are generally the imperfectly established.

The last point lends itself very easily to direct experiment. If a field of some well established perennial plant, as for instance, blue-grass (*Poa pratensis*) be selected, and several sunflower seeds, or thistle seeds, be planted in the center of it, it will happen that one or two plants of the composite species may reach maturity, and will then distribute seed outward in every direction. In three years time the composites will probably be ejected to the periphery of the field, and will have gained there a considerable foothold, while in the center of the field they will have gained but a slight foothold, and perhaps will not have retained what they had given them at first. A strong formation thus ejects to its periphery the plants that not in harmony with it, still strive to establish themselves. In the work cited above, I have termed this "the law of the ejection of the weaker." It may be seen operating in any wood or field, and is, I believe, one of the most important factors in the origin and modification of metaspermic species—although not generally recognized. It will be observed that while this ejection is purely biological, it nevertheless bears comparison with certain physical phenomena as when, for example, the water contained between the pores of adjacent solids is squeezed to the surface of the mass, and is thus ejected from its original, more central position.

It appears from the preceding analysis of conditions certainly existing and verifiable, that two adjacent formations do not actually come in contact, but are separated by the thicker or thinner band of tension-line species. It further appears that the tension-line group is made up of, and constantly replenished by plants ejected from the interiors of both formations, and reaching the tension-line as it were, to use a metaphor from chemical science, "in the nascent condition." This explains, or at least suggests the explanation of what otherwise would be difficult, viz., the large comparative number of species in the tension-line area, and the fact that higher types are aggregated there rather than in the solid portions of adjacent formations. For not only is the tension-area populated from the interiors of the adjacent formations, and thus comes to have a diversified group of inhabitants injected into it, but these inhabitants are likely to be the new forms, not in perfect harmony with the general mass of the formation in which they originated—and therefore they are ejected. Furthermore plants reach the tension-area "on the move"—their variations already begun and accentuated, it may be, by the forced journey to the periphery of the parent formation. Therefore both the actual numbers of species in the tension-area being great, and these species being derived from widely different habitat and environment conditions, together with the high degree of plasticity acquired in the ejection and after establishment in the tension-area, it becomes evident that it is precisely at such a contact-region between two formations that conditions are highly favorable for specific and generic and even ordinal variations to set in. Thus the increased number of species in the tension-area is seen to be in part the cause, and in part the result, of the high variability that is experimentally noted in such an area.

From the above, the explanation of the various peculiarities of the tension-line will readily be derived. Under the law of the struggle for existence, it will be seen that this struggle may be between individual and individual, individual and formation, and formation and formation. All three phases are developed at the tension-line and since the causes of evolution are working at their highest along this area, it happens that the results are numerically most apparent. The three phases of the struggle are not elsewhere so vividly brought to one's notice, for at least the third will be wanting or felt but indirectly. It appears, as a result of the examination, that the character of the tension-line, as made out by observation, is capable of illumination by experiment and of explanation by the general and well-known laws of evolution.

It is now my intention to show that the metaspermic plant-population of the Cretaceous, and especially of the Upper Cretaceous was a tension-line population. If this be possible, we shall expect that population to manifest tension-line characteristics.

In the first place it is necessary to gain some comprehension of the Cretaceous geography. I shall concern myself here only with the Upper Cretaceous of America. At the time of the deposition of the Cretaceous clays and sandstones, the North American continent was much more restricted than now. It extended little south of Illinois, and was cut by a great Mediterranean Sea into an eastern, larger and shorter, and a westtern, smaller and longer continent. The Mediterranean Sea extended from the south to the extreme north, and was doubtless highly saline in character. The coasts of this sea were generally low—at least this is derived from the evidence of the flora, according to Lesquereaux—but, here and there, doubtless varied by some rocky promontory or headland. The shores were marked by frequent bays and estuaries, and the rivers which flowed into the Cretaceous oceans were probably tide-streams to a marked degree. The general character of the country was low or morassic, but this was certainly broken by high uplifts, usually far inland. The coast-line of the ocean was therefore, so far as may be determined up to the present time, a generally low area, where vast stretches of sands or mud-flats were shifted about by the surf and by the inflowing waters of tributary streams. It is these sandy beaches and mud-flats that persist to-day as the Cretaceous rocks, bearing their countless imprints of archaic plants.

Considering next, for a moment, the character of the plant remains from the Cretaceous, we find that in the Lower Cretaceous, as studied by Fontaine, there are numerous ancient fern and cycadean types. These become less prominent in the Upper Cretaceous, so that in 1874, when, under the researches of Heer and Lesquereaux, already 130 species were described from the Dakota group, of these only five are ferns or cryptogamous plants, one doubtfully cycadean, six coniferous, two monocotyledonous, and the rest Dicotyledons—principally in the Archichlamydeæ, with only a very few (*Bicornes*, *Leguminosæ*, *Ebenaceæ*, etc.) referable to the Metachlamydeæ. The presence of the older types of cycads, conifers and ferns is important to be noted, for it is possible that the sole reason for their not appearing in countless numbers is the fact that they were cut off from the sandy-beaches and mud-flats by a thin but well-nigh continuous tension-line group of new and struggling Metaspermæ.

The study of shore-lines of modern seas is essential to the further working out of the hypothesis in process of development in this paper. The writer is not aware that observations have been made with the considerations in view that would make them useful either for support or objection. His own studies of sea-shore areas are confined to the observation of Cape Cod, Massachusetts, during a single month. While there he found that the older plants are more numerous in the inner regions, and the newer more numerous nearer the coast. The coast-line then seems to be a tension-area. While there are many pines on the Cape, these, so far as I could discover, were generally distributed inland, reaching the border of the sea only on high promontories, and on low lands being generally separated from it by strips of herbage, low shrubbery and hardwood timber. Further study of the sea-shore is needed along this line. But, apart from the testimony of the limited observation, it appears demonstrable that the coast-line, simply because it was peripheral, thus terminating ejections, must have developed a tension-line group of plants in Cretaceous times. That this tension-line was a relatively narrow one is proved by the great preponderance of metaspermic remains. For if it had been a broad one, the competition between older ferns and cycads, and newer metaspermic plants would doubtless have been sufficient to have brought down to the coast in larger numbers the more inland types of plants.

The picture of the Cretaceous plant physiognomy which these considerations brings before our eyes is of a great solid inland forest of conifers, cycads, ferns, and *Calamites* (?), bounded by a thin peripheral line of metaspermic trees, shrubs and herbs. This peripheral line extended up both sides of all estuaries, streams and rivers, and thus shut off the older, luxuriant and dominant flora from proper representation in the rocks of the period, as they have come down to us. An occasional inland plant was carried down some river and buried in the sands or shales at its mouth, and sometimes when the shores were high the inland types came close to the sea, and in the *Sequoias*, *Cunninghamites*, *Abietites*, *Zamieites* and other genera of the Cretaceous rocks, we derive a hint of the inland and general character of the plant population. The very fact, therefore, of the high metaspermic preponderance in the fossils—since it shows metaspermic plants to have been uniformly the coast population, and hence the tension-line population, is an argument in favor of supposing that metaspermic plants were actually very much less predominant in the general flora then than they were in Tertiary or Recent time.

Together with this disposition of the oft-repeated declaration that the Cretaceous Metaspermæ appeared with inexplicable suddenness, it will be seen that the other difficulty of their rapid and inordinate multiplication of species and genera is solved—so far as such notes constitute a solution. The tension-line position, with its tremendous increase of urgency to modify, and its concomitant increase of individual plasticity, explains the matter, so far as general explanations are of value. As the Metaspermæ began to fight their way back into the solid coniferous fern and cycadean forest, doubtless the same phenomena might have been noticed that are apparent to-day. The examination of a region where hardwood forest is encroaching upon coniferous is especially suggestive. The forerunners of the hardwood trees, various herbs and shrubs, insinuate themselves up the rivers and tributaries, closely followed by the trees themselves. In this way the coniferous plants and their numerous allies, the various heaths, cornels, club-mosses, etc., are isolated into phalanxes of smaller and smaller size. At last they become entirely surrounded by the invading types, and at the first opportunity are exterminated altogether. Without question similar scenes might have been noticed in the ancient Cretaceous forest when the tension-line group of plants waxed strong and began the backward march carried on through Tertiary time and resulting in the domination to-day of archichlamydeous trees in the extra-tropical forest regions, while metachlamydeous plants are in their turn characteristic of the tension-lines.

To summarize, in conclusion, what is at best a disconnected and imperfect attempt to contribute somewhat toward the analysis of a very difficult group of problems. A study of modern plant formations reveals the presence of tension-line areas in which higher types of plants may become aggregated, and where the general tendencies are toward a high degree of individual and specific variability. Such tension-lines are peripheral in position, and may be of different degrees of organization as they lie around formations of greater or less degree of integration. Newer types of plants are particularly likely to be forced into the tension-line habitat, under the law of the ejection of the weaker. Both observation and experiment show this. Such tension-lines doubtless characterized the Cretaceous formations as well as those of to-day. In them the weaker, because newer, types were aggregated, and in this way the littoral regions of the Cretaceous oceans came in all cases to be densely metaspermic in the character of their plant-population. The generally low elevation of the coasts contributed to this condition. The older types of plants, making up the bulk of the forest, were isolated from the shores and from the banks of streams, except very far inland. Consequently their remains are preserved only under exceptional conditions. That the metaspermic plants occupied the tension-line position indicates the preponderance of older types in the great inland stretches of country. The rapid appearance of new metaspermic types during the Cretaceous—and probably too in Jurassic time—was a result of the tension-line position into which they had been forced. The high development of the arboreal habit may be referred to similar causes.

The picture thus brought before the eyes differs much from the usual reconstructions of Cretaceous landscapes, but may be, nevertheless, a closer approximation to the truth. A final word may be added in regard to the conditions of the Triassic and even of earlier time. In those ages we may imagine the metaspermic types developing in the ancient forests of cycads —or even of *Lepidodendrons* and *Annularias*—and beginning their forced marches to the peripheral regions of the solid, archaic formations of their birth. Thus for century upon century they may have existed, and fail to appear in the fossils, because of their internal position in the formations. But when, after their long struggle for food and light and soil for support, they emerge upon the periphery of their parent formations we find them already arborescent or arboreal, and soon almost universal upon littoral areas. They then first come into a position where preservation in the rocks is possible.

AN EXTREME CASE OF PARASITISM.[1]

BY ROBERT HESSLER, A. B., M. D.

There is a small family of minute animals belonging to one of the sub-divisions of the arthropods which is of especial interest on account of the parasitic habits of many of its members. One of these, *Sarcoptes scabiei* De G., is parasitic on the genus Homo.

HISTORICAL.—It seems that the Jewish physicians dwelling among the Moors of Spain, in the 12th century, knew something about these animals and their causative relation to the affliction known as the itch. The discovery of the microscope early in the 17th century (1619) led to many investigations, some of which had reference to the itch mites. The first good description of the mite bears the date of 1687, and was written by Bonomo to Redi, at Florence. After this, various observers saw the insect, but frequently it was confounded with other mites, especially the cheese mite. Linnæus in his Systema Naturæ, 1734, had a very imperfect idea of it.[2]

In the century following the first appearance of the Systema Naturæ, the mites, as causes of the itch, were frequently the subject of heated discussions among medical men. The identity of the human itch mite was better known to naturalists than to physicians.[3] For instance, in a large treatise on skin diseases by P. Rayer, originally published in Paris in 1835, the author, in describing the causes of the itch, says: "Causes —Scabies is one of the most universally disseminated contagious diseases known; the most momentary contact of the fluid secreted by its vesicles is enough to communicate the infection; it is observed in every climate during every season of the year, attacking all ages and persons in every rank of life, without discrimination. It is most commonly observed, however, among the poor and wretched," etc. Further on he says: "Several authors of modern times have reported that they have discovered an apterous insect, almost invisible to the naked eye, within the vesicles of scabies, which they have described under the name of acarus scabiei," etc. The author does not state whether he believes this.[4]

---

[1] Read before the Indiana Academy of Science, December 28, 1892.

[2] Hebra, "Diseases of the Skin," 1868. P. 168–180.

[3] Hebra, "Diseases of the Skin," 1868. P. 180–181.

The labors of many observers in 1834 and 1836 firmly established the true nature of the itch or scabies. In 1845 and 1846 the minute anatomy of the insect was thoroughly studied and described.[5] The mite *Sarcoptes scabiei,* as the cause of the itch, was established beyond all doubt.

In recent medical works, I find there is little uniformity in regard to the systematic classification of this animal and its generic and specific names. The latter are variously given, the most popular seems to be *Acarus scabiei.* Frequently, all the different names are given. A recent treatise has it thus: "The acarus scabiei, sarcoptes scabiei, or sarcoptes hominis, commonly called the itch mite."[6] Authorities for names are never given. The accounts of the animal are often very brief and unsatisfactory. The size of the mites is variously given. According to some it is "very minute, almost microscopic;" according to others, "the size of a pin head." The pictures or figures of the mite differ greatly. In one work consulted—a standard text-book by the way—an entirely different mite is figured.[7] From the great numbers of mites which I had for comparison, I may say, without going into invidious distinctions, that the best figures I have seen are those in Taylor's "Atlas of Skin Diseases." Dr. Piffard's atlas contains an excellent photo-micrograph of the female acarus.

The itch mite is now universally called by entomologists Sarcoptes scabiei De Geer. The names Acarus scabiei and Sarcoptes hominis, given in many medical works should be dropped. Acarus and acari as synonyms for mite and mites are, of course, allowable.

The best description of the mite I have seen is Hebra's. It runs: "Body oval, tortoise-shaped, with indentations in the lateral margins. Skin provided with shallow, undulating, transverse furrows. Dorsal surface covered with numerous small and large appendages of a clavate or conical form, or resembling scales, and with spines resting on papillary elevations. Head apparently distinct from the trunk, with four pairs of jaws, and two strong, three-jointed palpi, placed near the jaws, and of the same length. Legs eight in number, five jointed; the first and second pairs provided with pedunculated suckers—the peduncles of the same length as the legs themselves, and having no joints; the third and fourth pairs in the female terminating in long bristles. In the male, the first, second, and fourth pairs of legs are all provided with suckers, the third pair alone having bristles; the epimera of the first pair united. Larva presenting six legs—the first and second pair with suckers, the third pair terminating in long bristles." In regard to size, Hebra says: "The adult acarus varies in size. On an average, its length is 0.45 mm.; its breadth, at the fourth ring of the thorax, 0.35 mm. The male is considerably smaller than the female. In length it measures 0.23 mm.; in breadth, 0.19 mm. The eggs of the itch mite are of an ovid form, and are 0.16 mm. long, 0.11 mm. broad." It is, perhaps, unnecessary to say that the size of the animal is entirely out of proportion to the commotion it occasions when its presence becomes known.

---

[4] Reyer, "Diseases of the Skin" (John Bell), 1845. P. 135–136.

[5] Hebra, "Diseases of the Skin." P. 187–489.

[6] Shoemaker, "Diseases of the Skin," 1892. P. 700.

[7] Frey, "Microscope and Microscopical Technology," Cutter, 1880. P. 562.

The presence of the mite on the human body is characterized by certain appearances and symptoms known as 'scabies' or 'itch'. Scabies comes from scabere, to scratch. "The name of 'scabies' is, at the present day, used to designate the numerous appearances produced on the skin by the presence of acari which dwell within it, and which, in obtaining food for themselves, and in propagating their species, give rise to a continual irritation of its component tissues. The morbid appearances themselves resemble, in many respects, those caused by other irritants, but, taken as a whole, they nevertheless present certain peculiarities, which justify our making of them a distinct form of disease" Hebra.[8]

"Though the (*Sarcoptes scabiei*) is the essential cause of scabies, it must be remembered that eruptions almost, if not wholly identical, are produced by other species of the Sarcoptes derived from horses, dogs, cats, camels, sheep and rabbits."[9] Such cases are, however, rare.

---

[8] Hebra, "Diseases of the Skin." P. 192.

It is, perhaps, unnecessary to add that the mite is never found in the body, only upon it, never in the organs or in the blood.

The human itch mite is perhaps coeval with man. It has certainly always existed as far back as written history goes.

Hebra, for good reasons, believes that many of the afflictions of the Israelites, as mentioned in the Old Testament, were nothing other than the itch.[10] Aggravated forms no doubt frequently occurred. Geologically speaking, the mites, as a group, are of recent appearance (Garman).[11]

The itch is, at the present time, becoming one of the rarer afflictions of mankind—like all filth diseases, it is gradually disappearing.

(In his Atlas of Skin Diseases (p. 319), Doctor R. W. Taylor says: " Until a few years ago, scabies was a rather uncommon disease *in this country*, but it has been noticed that in the various large cities and in some small communities, there has been of late, a remarkable increase in its prevalence." *Italics mine.*

In a recent letter to the writer, he expresses the belief that this is mainly due to the influx of Russian and Polish immigrants.

Cases are seldom seen outside of the slums of large cities; but it sometimes happens that if a case occur, say in a small town where none had appeared for years, perhaps half of the population becomes affected before its true nature is known, and appropriate remedies are applied. Vigorous medical treatment soon blots out an epidemic.

In an ordinary, acute or epidemic case of itch, the number of mites is quite small, probably not exceeding one hundred adult animals.

---

[9] Taylor, "Atlas of Skin Diseases." P. 327.

[10] Hebra, " Diseases of the Skin." P. 164–166.

[11] " Insect Life." Vol. IV., P. 182.

Recently I met with an extreme and rare case of the itch,[12] brought about by the presence in the skin of an immense number of itch mites. It shows to what extent parasitism will go under favorable conditions. The first detailed description of this rare form of itch was made by Hebra, of Vienna, in 1852, and who gave it the name of Scabies norvegica, or Norway itch, because the case was from Norway. Since then, other cases have been seen at various times and in different places, still, it is so rare that modern treatises on skin diseases do not describe it. Taylor's large "Atlas of Skin Diseases," devotes just two lines to it, as follows: "European writers, particularly of previous decades, have described a severe form of encrusted eczematous scabies, which they call Scabies norvegica, or Norway itch. It is not seen in this country."[13]

DESCRIPTION OF THE CASE.

The host of the mites was a middle-aged white man; he was partly paralyzed, and hence comparatively helpless. At the time of his admission to the City Hospital, his entire body was covered with thick, yellowish-white, leathery scales, the largest measuring over one inch in diameter, and over one-tenth inch in thickness. He was literally covered with scales like a fish.

On rubbing the body slightly, a large quantity of these scales fell off; rubbing more briskly removed an additional quantity, but with the production of small bleeding places (these scales were not crusts or scabs, they were epithelial proliferations). At a few places on the body crusts were found, mainly where the skin was bent, as at the joints. On account of the bleeding, no vigorous mechanical treatment was used at any time; the scales were gently rubbed off. A handful could be gathered daily. Despite this great alteration of the skin, the general health remained good. Taken in its entirety, the case was a puzzling one.

In a search for the cause of this eruption, and as an aid to the determination of the disease, some of the scales were sectioned. Itch mites were found in abundance, and the nature of the disease was soon established.

---

[12] The case was described from a medical standpoint in the *Indiana Medical Journal* for November, 1892, by Dr. Brayton and myself.

[13] Taylor, "Atlas of Skin Diseases." P. 827.

In order to study the case more thoroughly, a number of the scales were prepared by usual histological method. The scales were fixed and hardened by immersion in alcohol, stained in picrocarmine, finally imbedded in paraffin, sectioned, affixed to slides with clove-oil collodion, and mounted in series. The shrinkage in passing through this process was very slight. The differential staining in this case was peculiar: the epithelium stained red, the mites yellow; the eggs remained unstained, that is, white; the fæces appeared dark brown or black. In staining sections of normal skin with picrocarmine, the outer or horny layer stains a bright yellow, the underlying protoplasmic layers stain more or less deeply red. In the present case the epithelium is peculiar in that well-stained sections show very little yellow; this indicates that the component cells are still protoplasmic, and have not cornified.

The activity going on in the columnar layer to replace this constant and enormous loss of cells must have been great. Apparently a vicious circle was established; the presence of the mites irritating the skin—the skin, to protect or rid itself from the parasites, pushed out a large number of new cells. These succulent cells, however, furnished a good nidus for the mites. The mites increased, causing increased irritation of the skin, and this caused an increased proliferation of cells. Thus the case went on, until it assumed this extreme form.

I may here say, that under appropriate anti-parasitic treatment at the hospital, the mites were soon exterminated. The cause of the irritation once removed, the skin gradually regained its normal character.

NUMBER OF MITES.—In order to obtain an idea of the number of mites present on the host, that is, at the time the mites were present in greatest numbers, several scales were cut to measure one-half by one-eighth inch, sectioned and mounted serially. It will be readily understood that in such a procedure the mites were cut in various planes and directions; sometimes the head would be seen in one section, the body in one or two other sections, and the tail in still another. Many of the smaller embryos and eggs appeared entire.

Anyone who has attempted to get numerical results from serial sections, will understand the difficulty of obtaining approximately correct figures. In the present case, two counts were made in each of three series of sections, and the mean of these counts was taken as an approximately correct number.

Here are the figures:

Eggs and egg cases, 380.
Mites in all stages of development, 109.

Assuming that the above figures are approximately correct, we can make a little calculation: Multiplying the above numbers by 16, gives the number for one square inch; again multiplying by 144, gives the number for one square foot.

The average amount of epithelial covering on an adult human being, is said to be about 16 square feet. To be on the safe side, we will say that only half of the body was covered with scales, therefore, multiplying our last figures by eight, gives the number of eggs and egg-cases and mites on the host at the time of greatest abundance. Here are the figures in round numbers:

Egg cases and eggs, 7,000,000.
Mites, 2,000,000.

Since the reading of this paper, I tried to determine the proportion of eggs which are empty, that is, hatched. It seems that from one-half to three-fourths are empty shells.

As to the number of *living mites* in the shed scales. This is a difficult question. I am inclined to believe that only a small proportion were alive at the time the scales became detached.

Indianapolis Ind.

ON THE RELATIONSHIPS AND DISTRIBUTION OF THE NORTH AMERICAN UNIONIDAE, WITH NOTES ON THE WEST COAST SPECIES.

BY CHAS. T. SIMPSON.

For some years past, it has been generally acknowledged by students of the Unionidæ that a more natural system of classification was needed for that family than any that has hitherto been offered.

The genera or sub-genera of Rafinesque, Swainson, Agassiz and Conrad are of little value, for while certain typical species may be fairly referred to their divisions, in many others the characters fade out, or so blend together that it is impossible to place them, and sub-generic lines cannot be drawn with any degree of accuracy. Lea's arrangement, in which he divided the genera into two great groups, characterized by the presence or absence of a dorsal wing on the shell, and then into smaller divisions based on sculpture and form, was, like the Linnæan classification in botany, almost entirely artificial, consequently in many cases it brought together side by side forms not at all nearly related, and in others it widely separated those having close affinities, or even sometimes individuals of the same species.

I believe that the best and simplest system that can be adopted at the present, at least, is to place those species, which by the characters of the shell, by what we know of those of the animal, and by the facts of geographical distribution are most nearly related, in groups, each founded on and taking its name from some common, characteristic, and widely distributed form. Thus *Unio gibbosus*, which is nearly everywhere found throughout the Mississippi drainage area, is well known to every collector who has only a few species of Unios, and, with its elliptic oval and sometimes arcuate outline, thick epidermis, heavy cardinal and solid club-shaped lateral teeth, fairly typifies an assemblage of forms found from Canada to Central America, and from the Missouri river to Florida. *Unio liga-*

mentinus represents another section, *Unio complanatus* another, *Margaritana margaritifera* a fourth, *Anodonta ovata* a fifth, and so on.[1]

This plan of grouping by relationships is not a new one, having been adopted by R. Ellsworth Call, Wm. A. Marsh, and other students of the Unionidæ in the arrangement of their collections, and even Mr. Lea acknowledged some such affinities, though he did not put his ideas into practice.

It is found that a common assemblage of Unionidæ inhabits the entire Mississippi drainage basin, and that a considerable number of the species have a distribution covering the greater part of this area, as well as the whole of Texas, and even parts of eastern Mexico.

Those streams which fall into the Atlantic are peopled by an entirely different set of forms, the Appalachian chain seeming to act as a sharp barrier between the two regions. Many of the Mississippi Valley species have spread into Michigan, a few into Canada, into streams in New York that flow into the Atlantic, and two or three of these are met with in the Red River of the North, and the waters about Hudson Bay; while below the southern end of the mountain range, there is another mingling of groups.[2]

There are some forms which, apparently, may be with equal propriety assigned to either of two or three groups, but, in such cases, the location of the species with regard to drainage often gives us a key as to its relationship. There is a group of oval, rather smooth, compressed Unios, which may be fairly typified by *U. favosus*, which is found in the rivers from North Carolina to Alabama, several members of which very strongly resemble some of those of the Clavus Group, but the species of the latter assemblage are confined, with one or two exceptions, to the streams of the Mississippi Basin, while those of the former belong entirely in waters falling into the Atlantic or the Gulf. Another small group of rounded or oval inflated forms typified by *U. irrasus* likewise approaches in a few of its members some of the species of the *clavus* Group, but it is confined, so far as my knowledge goes, to the waters of the Gulf drainage; the Etowah, Coosa, Chattahoochee, and a few neighboring streams, and not a specimen has, I believe, ever come from Tennessee or the rivers emptying into the Atlantic, though several of them rise near the Chattahoochee.

---

[1] With such an arrangement, I believe that the North American Unios would fall into something like forty quite natural assemblages, whose group characters agree fairly well with their distribution so far as drainage areas are concerned. There would be some half dozen sections of *Margaritana*, and ten or a dozen of *Anodonta*.

[2] In many cases, the Unionidæ seem to have had no difficulty in migrating across the country from river to river; an example of this being the Mississippi Valley species which now inhabit all the rivers of Texas, and some of those of Eastern Mexico; while on the other hand species of South America extend up into Central America. The embryos, in some cases, may be carried by aquatic birds in the manner elsewhere mentioned in this paper; in others, they probably migrate across overflowed regions near the sea, in time of floods.

In Mexico and Central America, a totally different Unio fauna is found. Some of the Anodons extend into South America, and others belong to groups that have their metropolis on that Continent, while at the North there is a greater or less mingling of the species with those of the Mississippi Valley.

I have been greatly puzzled to account for the origin and relations of the few species found on the Pacific slope of North America. Two Unios, one Margaritana, and some half dozen Anodons, are all that have been hitherto credited to this immense region. Of the latter, *Anodonta wahlametensis*, *A. nuttalliana*, *A. oregonensis*, and *A. californiensis*, are believed by Dr. Stearns[3] and other competent conchologists to be merely variations of one species, although they often differ greatly in forms and general appearance. *A. wahlametensis* is provided with a wide dorsal wing, which gradually fades out through the other forms in the order I have given them, to *A. californiensis*, which is nearly or quite destitute of this appendage. This very abundant species is found from the Rocky Mountains on the east—in all the waters draining into the Pacific—to the coast, and from British Columbia on the north, well into Mexico on the south. Six shells in the collection of the United States National Museum (Mus. No. 117951), which were identified by Dr. Stearns as *Anodonta californiensis*, were collected by Mr. Duges in the Province of Oajacay.

---

[3] See paper on the History and Distribution of the Fresh Water Mussels, and Identity of Certain Alleged Species, by R. E. C. Stearns, Proc. Cal. Acad. Sci., Nov. 20th, 1882.

To the northward, this seems to be replaced by *Anodonta kennerlyi*, a species closely resembling some of the varieties of *A. cygnea* of Europe, and in Alaska another nearly related form, *A. youkonensis* of Lea, is met with. The latter is an absolute synonym of *A. herculea* Midd., of which specimens are in our collection, obtained in Kamschatka by Dr. Dall. I had noticed the resemblance of all these forms to that of the well known, abundant, variable, and widely distributed *Anodonta cygnea* and its variety *anatina*, and on hunting up the distribution of that species, I have been able to trace it through Northern Asia into Eastern Siberia. Any one who will carefully examine an extensive series of *Anodonta cygnea, anatina, herculea, youkonensis, kennerlyi, wahlametensis, nuttalliana, oregonensis*, and *californiensis*, cannot, I think, fail to notice their remarkable resemblance in many essential points: the peculiar and usually exact rounding of the anterior end of the shell, the flattening of the umbonal region, which, in good specimens, is generally overlaid with hair-like, greenish, radiating, wavy lines, and the singular cutaway in the posterior slope, all indicate close relationship, and the fact that they have sprung from a common origin.

I should unhesitatingly place these forms in a natural group, typified by *Anodonta cygnea.* Dr. Stearns, in the paper to which I have already alluded, believes that *Anodonta wahlametensis, nuttalliana, oregonensis*, and *californiensis*, are but variations of the European *A. cygnea*, and that *A. fluviatilis* of the Atlantic drainage is probably but another form of this protean species.

While I was formerly inclined to this view, a more careful and thorough examination of large quantities of material has induced me to somewhat modify my opinions. Though the *nuttalliana* and its variations are very close to *cygnea*, I do not, at present, feel justified in uniting them specifically, and I regard the *A. fluviatilis* as the type of a rather nearly related group, having a distribution from Canada to Florida, in the streams which fall into the Atlantic. The shells of this section are generally more inflated than those which belong with *cygnea;* they are not flattened at the umbonal region, and are more full on the dorsal slope.

If I am right in this view of the case, it is probable that the group of *Anodonta cygnea* is confined in North America to the Pacific slope, and that its connection with the rest of the species in the Old World was made over a land passage between Asia and North America. Dr. Theodore Gill informs me that the boreal fresh-water fishes of the Old World and those of the western slope of our continent have a similar distribution to the *cygnea* group of Anodons as I have outlined it.

One of the most remarkable of the Unionidæ, *Anodonta angulata*, is an inhabitant of the waters of Oregon, Washington, and California. The anterior end of this species in ordinary specimens is much narrowed; the posterior is wide and inflated, and, running from the beaks to the posterior ventral regions is an extraordinarily developed sharp-edged ridge or keel. Nothing in the least resembling this peculiar form has hitherto been found. But the National Museum possesses specimens in which the anterior end is wider, and the keel is far less developed, and others in which it is almost entirely wanting, and that indefatigable collector, Mr. Henry Hemphill, has sent me a photograph of a specimen in his collection which has no vestige of a ridge, but is furnished with a slight groove running down the posterior slope. Recently, Messrs Mearns and Holzner, of the International Boundary Commission, have sent to the National Museum a large number of specimens of what is apparently a new species of Anodonta, from San Bernardino Ranch, Arizona, which, externally, very much resembles some of the varieties of *Unio complanatus*, but has a very different texture, and, on comparing these shells with Mr. Hemphill's photograph, and the more compressed specimens of *A. angulata*, I was convinced at once that they group together. They have the same outline, the same beak sculpture, and, when viewed from the dorsal or ventral region, have a much greater diameter through the posterior area than elsewhere, and nearly all exhibit the slight groove I have mentioned.

The type of *Unio oregonensis* was presented to Mr. Lea by Mr. C. M. Wheatley, and the former mentions that the latter reserved a specimen for his own collection. Lea's shell is said to come from the Columbia River, and is in rather bad condition, as it is dead and somewhat eroded. I have very carefully examined it, and after comparing it with everything that I could think might be related to it, I have come to the conclusion that it is a form of the protean *Unio luteolus.*

This is the most abundant, widely distributed, and variable Unio in the world, being found almost everywhere throughout the 1,200,000 square miles of the Mississippi drainage basin, through Texas, and probably into Mexico, in New York in some of the streams that flow into the Atlantic, and northward in the vicinity of Hudson Bay, and probably throughout the British possessions east of the Rocky Mountains. I have traced it up the Missouri River to near its source, and when it is taken into consideration that the Marias, a tributary of this stream, heads within a few miles of Flathead Lake on Clarkes River, a branch of the Columbia, and that the embryos of Unios are provided with hooks by which they can attach themselves to the feet or feathers of aquatic birds, it is very easy to see how this species might have been carried from the waters of one drainage system to those of another. *Margaritana margaritifera,* which inhabits Europe, Northern Asia, and the Pacific slope of North America, is also found in the upper Missouri. Two specimens of *Unio luteolus* in the Museum collection, from the North Shore of Lake Superior, are almost exactly like Lea's type of *U. oregonensis.*

So far as I am aware, nothing is stated of *Unio famelicus,* the other Pacific slope species, save that Gould received his type from Dr. Pickering, and that it is said to have come from Walla Walla, Oregon. The type is in the National Museum, *and is undoubtedly a young Unio ellipticus* Spix, from Brazil, a species belonging to an extensive South American group, characterized by having oblong, compressed, sulcate shells, which are often granulated on the ridges. Any one familiar with Unios would know at once on carefully examining the type, that it came either from South America, or some part of the Southern Hemisphere of the Old World, a fact which is made evident by its form, its peculiar greenish olive epidermis, the strong growth lines, and, most of all, the compressed, parallel, cardinal teeth of the right valve. It is perfectly safe to say that the locality given is an error, and that this species was never found in the United States.

EDITORIALS.

EDITORS, E. D. COPE, AND J. S. KINGSLEY.

rics as to the publication of original books by the four
ons of readers have recently appeared. America and
ain have published during the last decade between four
ousand books each. In America the proportion of fic-
nsiderably larger than in Great Britain. In Germany
of books published in the same time was over ten
ith a smaller absolute number of works of fiction than in
in. The figures for France fall between those of Great
Germany.

f the fact that America exceeds in population each of the
med, and includes in this population a greater number of
se statistics are not pleasing to our national pride. Great
h a much smaller population, is our superior in the quality
oduced, and yet falls far behind Germany.

several reasons for this state of affairs. One is the absence
ory education, which exists in an effective condition in
Another, and probably more efficient cause, is the fact
blishers think it necessary to bring out books of value in
e style, so that they are out of the reach of students gen-
e same cause probably conduces to the depression in the
business in Great Britain. If American students could
ientific and other serious books at as low rates as can be
rmany, the general standard of intelligence would be greatly
If American publishers would get out cheap editions of
ure they would greatly profit by it. The extravagant style
pular scientific books are published in this country is an
n. There is no nobility here whose attention it is neces-
for material reasons, nor is social position the object for
cientist is supposed to be striving. Hence the absurdity of
ence in a garb which can attract a small class only, while
r inaccessible to the mass of mankind. The supposition
will not buy solid literature is negatived by the experience
y. If American publishers will not publish cheap works
s we shall become dependent on foreign countries, whose
oon become accessible to us by the removal of the oppress-
intelligence, known as the protective tariff.

—We have received the first number of the New Journal of Geology published by the geological faculty of the University of Chicago, and printed by the press of the University. It is edited by six members of the United States Geological Survey, together with twelve associate editors, of whom five are Americans, and one resides in each of the following countries, viz.: Canada, Great Britain, Germany, France, Austria; Norway, and Sweden. The articles of the number are by Messrs Geikie, Holmes, Williams, Chamberlin and Salisbury, and are all of much interest. Editorials, Reviews, Abstracts, and Acknowledgments follow. The beginning of this new journal is auspicious, but it remains with the future to determine whether it can be continued on its present basis. On the face of it the proposition is broad, but the basis is narrow. The names of the associate editors indicate cosmopolitan aspirations, but "the immediate editorship," we are told in the announcement, "will rest with the geological faculty of the University of Chicago," who are all members or ex-members of the U. S. Geological Survey. The leading article is by a foreigner, but this is appropriate in a city which has legal holidays in honor of William of Germany and Saint Patrick. We will observe with interest whether such a constitution can stand the test of time, or whether it will meet the difficulties which befel the image of the prophetic vision, in which the geological order was reversed, since the head was of archean gold, but whose feet were of glacial clay. Not but that the precious metal may be found in the superficial stratum in this instance; but placer deposits in glacial drift are not as permanent as those of greater geologic age. We have an excellent geological magazine, the American Geologist, which is not identified with any institution or institutions, and whose editorial corps is not interested in supporting geological literature in other countries. While, therefore, we welcome all additions to scientific periodical literature, it is always with a reservation which requires that they shall be viable infants, endowed with a good constitution.

—A movement is on foot in New Zealand to secure an island not far from the coast as a preserve for the native animals and plants of that country. In view of the extreme importance to biological science of the preservation of the remarkable types of this ancient flora and fauna, and in view of the other fact that many of its representatives have become extinct within recent times, and others are disappearing, we sincerely hope that this effort will be successful. If there is any doubt about it, a concerted effort should be made by the scientific men of all countries to secure favorable action from the colonial legislature.

RECENT BOOKS AND PAMPHLETS.

ALLEN, H.—On a New Subfamily of Phyllostome Bats.——Description of a New Genus of Phyllostome Bats.——On Temminck's Bat, *Scotophilus temminckii.* Extr. Proceeds. U. S. Natl. Mus., Vol. xv. From the author.

Biennial Report of the Director of the Illinois State Laboratory of Natural History, 1891–1892.

BOLLMAN, C. H.—Description of *Fontaria pulchella* from Strawberry Plains, Tenn. Extr. Proceeds. U. S. Natl. Mus., 1888. From the author.

BONAPARTE, R.—La Novège et la Çorse, résumé de la conférence. Extr. Le Globe Journ. Geog., T. 28, 1889. From the author.

BRIGHAM, A. P.—A Chapter in Glacial History with Illustrative Notes from Central New York. Extr. Trans. Oneida Hist. Soc., 1892.

—— The Geology of Oneida County, New York. Extr. Trans. Oneida Hist. Soc., 1887–'88.

——Rivers and the Evolution of Geographic Forms. Extr. Bull. Am. Geog. Soc., 1892. From the author.

Bulletin of the Illinois State Laboratory of Natural History, Vol. iii, 1892.

BURMEISTER, G.—Anales del Museo Nacional de Buenos Aires para dar á conocer los objectos de Historia Natural Muevos ó Poco Conocidos conservados en este establecimiento. Entrega Decimaoctava, 1891. From the author.

CROOK, A. R.—Ueber einige fossile Knochenfische aus der mittleren Kreide von Kansas. Separat-Abdruck aus Palaeontographica, xxxix, Band, Stuttgart, 1892.

CROSS, WHITMAN.—The Post-Laramie Beds of Middle Park, Colo. Extr. Proceeds. Col. Sci. Soc., 1892. From the author.

DORSEY, J. O.—The Cegiha Language. Contributions to North American Ethnology, Vol. vi, Washington, 1890. From the Dept. of the Interior.

EARLE, C.—A Memoir upon the Genus Palæosyops Leidy and Its Allies. Reprint Journ. Phila. Acad., Vol. ix, Oct., 1892.

——Revision of the Species of Coryphodon. Extr. Bull. Am. Mus. Nat. Hist., Oct., 1892.

——The Variability of Specific Characters as Exhibited by the Extinct Genus Coryphodon. Extr. Science, July 1, 1892. From the author.

FOSHAY, P. M.—The Fertility of Hybrids. Extr. Medical News, 1892. From the author.

GARMAN, H.—A Synópsis of the Reptiles and Amphibians of Illinois. Bull. Ill. State Laboratory, Vol. iii, 1892. From the author.

GARNIER, DR.—The Reptiles of Canada. Extr. The Land we Live In. From the author.

GEINITZ, H. B.—Bericht über die neue Aufstellung in dem königl. Mineralogischen Museum zu Dresden. Sitzung der Gesellschaft Isis in Dresden, April, 1892. From the author.

GILL, TH.—On the Proper Generic Name of the Tunny and Albicore. On the Psychrolutidæ of Guenther. Extr. U. S. Natl. Mus., 1888. From the author.

HAYES, C. W.—Report on the Geology of Northeastern Alabama and Adjacent Portions of Georgia and Tennessee, 1892. From the author.

Holm, Th.—The Flora of the Dakota Group. Extr. Botanical Gazette, Vol. xvii. From the author.

Howes, G. B.—On the Affinities, Interrelationships, and Systematic Position of the Marsipobranchii. Extr. Trans. Biol. Soc. Liverpool, Vol. vi.

——On the Pedal Extremity of the Dorking Fowl, with Remarks on Hexadactylism and Phalangeal Variation in the Amniota.——Notes Upon the Shoulder Girdle of Certain Dicynodontid Reptiles. Extrs. Jour. Anat. and Physiol., Vol. xxvi.

——On the Arrangement of the Living Fishes, as based upon the study of their Reproductive System.——On the Customary Methods of Describing the Gills of Fishes. Read at the Cardiff Meeting of the British Assoc., 1891.

Howes, G. B., and J. Harrison.—On the Skeleton and Teeth of the Australian Dugong. Read at the Edinburgh Meeting of the British Assoc., 1892. From the author.

Jordan, D. S.—List of Fishes collected by Alphonse Forrer about Mazatlan, with descriptions of two new species, *Heros beanii* and *Pœcilia butlerii*. Extr. U. S. Natl. Mus., 1888. From the author.

Keyes, C. R.—Iowa's Natural Resources. Extr. Iowa State Register, July 12, 1892. From the author.

Lydekker, R.—On a Collection of Mammalian Bones from Mongolia. Extr. Records Geol. Surv. India, Vol. xxiv, 1891. From the author.

Macoun, J.—Catalogue of Canadian Plants. Part VI, Musci. From the author.

Newton, E. T.—On a Skull of *Trogontherium cuvieri* from the Forest Bed of East Runton, near Cromer. Extr. Trans. Zool. Soc. London, Vol. xiii, Part IV, 1892.

——The Vertebrata of the Pliocene Deposits of Britain. Extr. Mem. Geol. Surv. of the United Kingdom, 1891. From the author.

Niblack, A. B.—Ethnology of the Coast Indian Tribes of Alaska. Extr. Proceeds. U. S. Natl. Mus., 1888. From the author.

Pocta, Ph.—Ueber Spongien aus der oberen Kreide Frankreichs in dem k. Mineralogischen Museum in Dresden, mit Vorwort von Dr. H. B. Geinitz. From the author.

Pouchet, M. G.—Nouvelles observations sur la Sardine océanique. Extr. Comptes rendus, juillet, 1889.

Quarterly Bulletin of the University of Minnesota.

Report of the Commissioner of Education, 1888–'89, Vol. i. From the Dept. of the Interior.

Rohon, J. V.—Die Obersilurischen Fische von Oesel. Mém de l'Acad. Sci. de St. Petersbourg, vii E Serie, T. xxxviii, No. 13, 1892.

——Ueber Pterichthys. Separat-Abdruck a. d. Verh. d. Russ. Kais. Miner. Ges. zu St. Petb., Bd. xxviii, 1891. From the author.

Sablon, L.—Nos Fleurs. From Armand, Collin & Cie, Editeurs, Paris, 1892.

Schellwein, E.—Die Fauna des Karnischen Fusulinenkalks, 1. Aus Palæontographica, Neununddreissigster Band. Erste Lieferung, Stuttgart, 1892.

Sears, J. H.—Geological and Mineralogical Notes, No 5. Extr. Bull. Essex Inst., 1892. From the author.

Simpson, C. T.—Notes on the Unionidæ of Florida and the Southeastern States. Extr. Proceeds. U. S. Natl. Mus., Vol. xv. From the Smithsonian Institution.

Smithsonian Report U. S. National Museum, Part II, 1886; Part II, 1887. From the Museum.

TODD, J. E.—Notes on the Geology of Northwestern Iowa. Extr. Proceeds. Iowa Acad. of Sciences, 1891.

——Striation of Rocks by River Ice. Extr. Am. Geol., Vol. ix, 1892. From the author.

TRUE, F. W.—An Annotated Catalogue of the Mammals collected by Dr. W. L. Abbott in the Kilimanjaro Region, East Africa. Extr. Proceeds. U. S. Natl. Mus., Vol. xv. From the Smithsonian Institution.

United States Commission of Fish and Fisheries, Part xvi. Report of the Commissioner for 1888.

WHITEAVES, J. F.—The Orthoceratidæ of the Trenton Limestone of the Winnipeg Basin. Extr. Trans. Roy. Soc. Canada, Vol. ix, 1891. From the author.

RECENT LITERATURE.

The Woodland of the Southwest, by Chas. F. Lummis.[1] —For those readers who have read but a few books of travel on the Southwest, this snug little volume will be quite a revelation. The contents of the twenty-two chapters scarcely contain anything that has been written or sketched before, except a few pages on the Moqui Snake dance and Indian superstitions. The thoroughness of his familiarity with Pueblo customs and folklore is only equalled by the graphic qualities of his style. In looking about the "strange corners" which the author describes, we are first attracted by a prairie-dog hunt, with the Navajo Indians put in scene to fill their larder. White people of the Southwest never think of killing this rodent for food, because it is so difficult to attain with a rifle ball; but these natives utilize abundant downpours of rain to conduct the floods into their tunnels and afterward haul up their dead bodies for a feast. To get rid of the prairie-dog plague, people have proposed to kill them with poisoned apple-quarters. The belief in witchcraft is as potent among the whites and Indians of New Mexico as it ever was during the middle ages. Manslaughter is committed for any act arousing even the suspicion of witchery, and the fact that one-half of the Isleta people are wizards and witches speaks loud enough. The "Finishing an Indian Boy" shows principles of education in full force now, which our Northern Indians began to drop as early as one century ago. In the chapter "The American Sahara" the wide waste is delineated in colors none too sharp or cruel. Lieut. Wheeler is mentioned by mistake as its earliest explorer instead of Lieut. Whipple. The marvelous wealth of objects presented in Lummis's volume will attract ever and again the class of readers and tourists which seeks instruction rather than pleasure in books of travel, and they will hold it dear as a publication of really scientific value, standing far above most of the productions of our present sensation-loving period of literature.

"The Wanderings of Cochiti" is another very interesting sketch from our "Wonderland" on the upper Rio Grande. It is printed in the "Century Magazine," January, 1893, and describes and also pictures in photographic reproductions the people, customs, history and scenery of Cochiti, one of the Quéres Pueblos of Northern New Mexico, and the celebrated gorge of Tyú-on-yi with its rock carvings in the vicinity of that pueblo. The scene of Bandelier's archæologic novel, "The Delight-Makers," is placed in that locality.

---

[1] Some strange corners of our country, the Woodland of the Southwest, p. 270. 12 mo., richly illustrated. New York, The Century Co., 1892.

Macmillan's Metasperma of the Minnesota Valley.[2]—In this thick, handsomely printed book, in which excellent paper and an equally excellent selection of type are manifest, we have a notable departure from the usual "report" issued from a State printing office. So unlike the State or Government reports is this volume that one has to turn to the imprint to satisfy himself that it is actually the work of the State printer. If this model is followed in the future by other State printers then indeed is this book a noble pioneer in a much needed reform in State book making.

Turning to the more important part of the book, namely its contents, we find that the author also has broken away from the traditional form and style of State reports, and has given to the botanical world a useful book. He first of all chose an area with natural boundaries, instead of one arbitrarily set off for political and not scientific purposes. In his choice of the Minnesota Valley the author seems to have been fortunate in having to deal with an area of more than usual interest, but it is likely that if in other States natural areas were studied, similar interesting features would be discovered.

The list of plants includes 1174 species and varieties, a large number when one remembers that the area covers but 16,000 square miles, and the only plants enumerated are the Metaspermæ (Angiospermæ).

These species are found in prairies and woodlands, in "meadows, marshes, swamps and bogs." There is, however, a considerable preponderance of the rolling prairies. The soils are not much varied, and the difference in altitude is little more than 1300 feet from the lowest point at Fort Snelling (688 ft.), to the highest hills in the eastern part of North Dakota (2000 ft.).

The author aims to trace the history of the flora of this valley. To him it is not enough to tell what plants occupy the territory; he seeks to show how they came to do so, from whence they came, and why they came. Accordingly we have a series of discussions such as we rarely (if ever) have had in books dealing with local floras. Thus one finds such headings as these: "The Dynamic Relations of Plants,"

---

[2] Geological and Natural History Survey of Minnesota. Conway Macmillan, State Botanist. *The Metaspermæ of the Minnesota Valley*, a list of the higher seed-producing plants indigenous to the Drainage Basin of the Minnesota River, by Conway Macmillan. Reports of the Survey, Botanical Series, i, Dec. 29, 1892, Minneapolis, Minnesota, pp. xiii, 826. Large octavo.

"General Features of Plant Distribution," "The General Factors in Floral Differences," "Pressures and Tensions," "Outlines of Metaspermic History in the Northern Hemisphere," etc.

Enough has been said to indicate that this work is an unusual one. It is impossible to give a summary of its many interesting chapters. Perhaps the conclusion which the author reaches that while the region is geographically central in the continent, the flora is "preponderantly southeastern," sums up the results of the work as well as any which could be given.

It remains to speak somewhat more as to the list itself. In the first place it is ultra-modern in nomenclature and arrangement. Engler & Prantl's work, "Die Natürlichen Pflanzenfamilien," is followed in the sequence of the families, so that one finds the simple Monocotyledons first (*not* the grasses, and sedges, however), and following the well-known succession of families, reaching the culmination of the Dicotyledons in the Compositæ. The manuscript of the book went to the printer four months before the Rochester meeting of botanists last year, hence it does not conform in all respects to the present rules as to nomenclature. Thus the initial date adopted for the genera is 1737, instead of 1753, and now and then one finds a specific name identical with that of the genus to which it belongs. In the preface, which bears date of Dec. 24, 1892, the author records his hearty acquiescence with the action of the botanists at Rochester, and suggests the changes which must be made in order to bring the nomenclature in the book into harmony with the present code.

A very valuable feature of the work is the fulness of citations of synonyms, with dates. Thus one finds:

LACINIARIA Hill, Syst. Veg. iv, 49 (1762).
    Psilosanthus Neck. Elem. (1790).
    Liatris Schreb. Gen. Pl. 572 (1791).
    Calostelma Don, Sweet. Brit. Fl. Gard., 2, 184 (1838).

The following may serve to show the treatment of species:

LACINIARIA SQUARROSA (Linn.) Hill. Syst. Veg. iv, 49 (1762).
    Serratula squarrosa Linn. Spec. 88 (1753).
    Pteronia caroliniana Walt. Fl. Gar. 292 (1788).
Liatris squarrosa Willd. Spec. III, 1065 (1802).

Then follow many references to descriptions or lists giving localities, followed by statements as to its general and particular distribution, etc.

The book will be read with interest by all advanced botanists, and it is to be hoped that it will serve as a model for future plant lists.

CHARLES E. BESSEY.

Ridgway on the Anatomy of the Humming-Birds and Swifts.—A Rejoinder.—What I say here has reference to Mr. Ridgway's reply to my review of his "popular monograph of the Humming-Birds," which review appeared in the October NATURALIST, and his reply in the December following issue of that journal (1892, p. 1040).

In that reply Mr. Ridgway remarks that his description of the humming-bird's tongue "is substantially a condensation of MacGillivray's"[3] (in Audubon's Birds of America, Vol. iv, pp. 197, 198), and that his "knowledge of the subject is based chiefly upon it." Now one of the errors I pointed out in Mr. Ridgway's "Humming-Birds" was that he claimed the tongue in those birds was "hollow," and yet he now states that his account is a condensation of Macgillivray's lucid description. Let me contrast the statement of the two authors, thus:

MACGILLIVRAY.	RIDGWAY.
In the tongue of the humming-bird "there are, it is true, two cylindrical tubes, but they gradually taper away toward the points, and instead of being pervious, form two sheaths for the two terminal parts or shafts of the glosso-hyal portion of the tongue, which run nearly to the tip." (Aud. Birds of Amer., Vol. iv, p. 198).	In the humming-birds "The tongue is slender and very extensile, like that of the woodpeckers. * * * * * Instead, however, of its being as in the woodpeckers, solid and tipped with a barbed, horny point, it is hollow." (The Humming-Birds, p. 290).

These sentences, *in either case*, are completed by their respective authors in their calling attention to the bifurcated condition of the extremity of the tongue, and, as that is not the point in question, I purposely omitted it.

Farther on in his reply Mr. Ridgway remarks that his knowledge of the structure of the humming-birds is to some extent based upon the "later dissections of thirteen species," made by Mr. F. A. Lucas, "instead of one, as in the case of Dr. Shufeldt's 'extensive dissections.'" If my friend will again allow me to invite his attention to the literature of the subject, I would call it to my memoir published in the *Linnean Society's Journal*, Vol. xx (London), pp. 303, 304, where he will find that I had the following material for my "extensive dissections," namely, spirit specimens of *Cœligena clemenciæ, Trochilus colubris, T. alexandri, T. anna, T. platycercus, T. rufus, T. calliope* and *Iache latirostris*—in all 3 genera, 8 species, and 62 specimens. When this material was presented by me to the collections of the U. S. National Museum, Mr. Lucas remarked that it was the largest and best collection of spirit specimens of North American humming-birds ever donated to the institution by one individual. It naturally seems to me that the further Mr. Ridgway goes into this subject the greater is the display of his ignorance of the literature of it. Now when I charge a writer with being ignorant of the literature of a subject I take the pains, as I have done above, to point out wherein his ignorance lies, and do not resort to the remarkable method adopted by Mr. Ridgway—thus, and alluding in his reply to myself, he continues: "Apparently he is not familiar with the literature of the subject, for, if he were posted, he would know that leading authorities on avian comparative anatomy are overwhelmingly if not unanimously against his side of the question." Rather remarkable logic—especially to be immediately followed up in the very next sentence by, "I would therefore suggest that he consult Fürbringer, Parker, Garrod and Gadow, and thus learn regarding the matter which he handles with so much assurance. Even a careful perusal of Huxley (whom, by some strange hallucination, he imagines his abettor), may also prove instructive to him (p. 1040)." To this I would simply reply that in so far as Professor Fürbringer is concerned, I can say that, thanks to his generosity, I am the fortunate possessor, not only of many of his works upon comparative avian anatomy, but also his two massive and superb volumes so familiar to us all, and while I can thank him for his numerous and courteous references to my memoirs in that great work, I must dissent from his views in the matter of the taxonomy, of the Cypseli and Trochili. Apparently Professor Fürbringer had not seen my Linnean memoir, which was defended for me by Professor Parker before the London Linnean Society a number of years ago. There is a reason for that, however, as both works appeared early in 1888.[4]

---

[3] If Mr. Ridgway will permit one who has long been familiar with the works of "the Scotch anatomist," I would "kindly invite" his attention to the fact that that careful dissector of birds spelled his name Macgillivray, and *not* MacGillivray, as Mr. Ridgway always writes it.—R. W. S.

---

[4] Shufeldt, R. W., Studies of the Macrochires, morphological and otherwise, with the view of indicating their relationships and defining their several positions in the System. Linn. Soc. Jour.—Zool., Vol. xx, pp. 299–394, Pls. xvii–xxiv (Communicated by W. K. Parker, F. R. S., F. L. S., 19th Jan., 1888). When I spoke of my extensive dissections this was the work I had reference to, and not to the brief note in *Forest and Stream*, as Mr. Ridgway seems to think. It stands to-day as the most extensive paper on the *entire structure* of the Humming-birds ever published by a single individual.

As for Professor Parker, I can say that I had the honor of being one of his constant correspondents for a number of years, and I have from him *several hundred* letters. A year or so before his lamented death it was his intention to supplement my work upon the "Macrochires," and I had sent him some material to that end. I have letters to show from him that he practically agreed with me in the taxonomy of the swifts, swallows and humming-birds, and he proposed to figure one of the latter "as big as a Cochin-China cock!" It is to the loss of the science of systematic ornithology that he never lived to accomplish it. Next as to Garrod. My library contains a copy of his "Collected Scientific Papers," a work I have had occasion to refer to almost daily since its appearance. He was disposed to classify birds upon altogether too few characters; there is no evidence whatever in his work that he ever critically compared the *entire structure* of a humming-bird with that of a swift; he notes simply the fact that "the tensor patagii brevis (in the Cypselidæ and Trochilidæ) and the pterylosis are characteristic, as is the sternum," but he failed to point out how widely they differed morphologically (p. 222). I dissent altogether from his views not only upon his taxonomy of the Cypseli and Trochili, but also from much else that he has left us upon the classification of birds. I must ask Mr. Ridgway for the title of any work from the pen of Professor Gadow wherein I may find a critical comparison of the *entire structure* of a swift and a humming-bird. I know of none, though I *do* know, as do many others interested in the classification of birds, that at the present time Dr. Gadow is hard at work upon probably what will prove one of the best *practical* schemes for the taxonomy of the class, and it will shortly appear. He has already done me the great honor in inviting me to submit my own views to him on the subject, and in a valuable letter I have just received from that able taxonomer I find that he is prepared to admit that the goatsuckers no longer should be retained in the same group with the forms they have usually been associated with heretofore, and he says, "I shall reconsider the position of the Caprimulgidæ and elevate them perhaps on account of Steatornis as Caprimulgi, thus making the difference from Cypselidæ and Trochilidæ more marked, although I shall not go so far as Fürbringer has done." Mr. William Brewster, of Cambridge, the distinguished American ornithologist, and one of the Committee responsible for the "Check-List" of the American Ornithologist's Union, and the classification therein set forth, having read my contribution to *The Ibis* (January, 1893) on Swifts and Humming-birds, writes me under date of February 13, 1893: "It is comforting to find that there are now, among scientific men of distinction, champions of the belief of my boyhood days that a swift is merely a peculiar kind of swallow."

Now as to my "strange hallucination" in the matter of Professor Huxley's views upon the classification of the Swifts, Swallows, and Humming-birds. I have a well-worn copy of his famous P. Z. S. memoir of 1867—one of the most remarkable contributions ever written upon the classification of birds—and, I may add, a *perfect monumental beacon*, warning comparative avian anatomists for all time in their attempts to classify birds, against trusting to any single set of characters. In his "Cypselomorphæ" Huxley placed only the Swifts, Humming-birds and Goatsuckers (pp. 468, 469). It was done upon only too few characters, and mainly based upon the osteological ones seen at the base of the skull. But Huxley believed the vomer of a Humming-bird was "truncated at the anterior end," an error which both Parker and myself independently pointed out for him. But a quarter of a century is a long time in comparative anatomy (1867-1892), and if Professor Huxley has kept up with the literature of the subject he may hold entirely different views at the present writing. This would appear to be the more probable, as his misgivings were sufficiently strong as to have him write in his 1867 memoir that "In their cranial characters the Swifts are far more closely allied with the Swallows than with any of the Desmognathous birds, the Swift presenting but a very slight modification of the true Passerine type exhibited by the Swallow (*loc. cit.* p. 456). May I ask Mr. Ridgway what he thinks Professor Huxley meant when he wrote that sentence? And does he believe that to-day Professor Huxley would retain the Caprimulgi with the Humming-birds and Swifts together in one group and consider it to be a natural one?

One word more and I have done for the present. In the case of doubtful affinity among birds, as with all other forms, there is but one true way of getting at a solution, and that is to critically weigh and compare *everything* that is known about the one group with *everything* that is known about the other, before finally deciding. Now I challenge Mr. Ridgway to take any species of North American Humming-bird and any species of North American Swift, and arrange in two columns in a comparative way all that is known about either species, paleontologically, biologically, morphologically, or otherwise, and then upon summing up give any real reason why the Trochili and the Cypseli should be considered to constitute by themselves a natural group of birds. I have very serious doubts as to his ability to do this. If he ever undertake such a task, he must bear one thing well in mind, and that he must not do not do it with the view of "exploding" any one's "peculiar notions," but rather with the view of getting at the truth of the matter. Then, too, do not condemn another's views simply because "leading authorities on avian anatomy are overwhelmingly if not unanimously against his side of the question (p. 1040)." That has been the case with a great many anatomists in the world's history, and even I can remember when the "leading authorities" overwhelmingly if not unanimously believed that *Chamæa* was a *Wren;* but the present writer in his published account[5] based upon his "extensive dissections" claimed it was most nearly related to the Bush-Tits (of the genus *Psaltriparus*), to which opinion the "leading authorities," who have reviewed my work, are now rapidly coming. But no doubt Mr. Ridgway remembers something of this; he most assuredly does if he is familiar with the literature we have upon the subject.

R. W. SHUFELDT.

Animal Coloration.[6]—This volume has grown out of materials collected by Mr. Beddard for the Davis lectures delivered at the Zoological Garden of London in 1890. It contains the latest information as to the phenomena of coloration exhibited by animals, together with the most important theories upon the subject, including those of Dr. Eisig and M. Stolzmann, which had not previously found their way into works of a popular character. Mr. Beddard groups his facts under the following heads: Coloration Affected by Environment; Protective Coloration; Warning Coloration; Protective Mimicry; Sexual Coloration.

In summarizing the facts concerning Protective Mimicry, the author concludes that the theory of Natural Selection alone does not satisfactorily explain the remarkable resemblances included under that caption.

The chapter on Sexual Coloration calls attention to some objections to Darwin's theory of sexual selection, and gives briefly a sketch of the views of Mr. Stolzmann and those of Mr. Wallace.

Mr. Beddard's objections to the use to which the theory of Natural Selection has been put by various naturalists, and especially by Messrs

[5] "On the Position of Chamæa in the System." The Jour. of Morph., Vol. iii, No. 3, pp. 475–502, figs. 1–8.

[6] Animal Coloration, an Account of the Principal Facts and Theories Relating to the Colors and Markings of Animals, by Frank E. Beddard, M. A. Oxon., F. R. S. E., with four colored plates and wood cuts in the text. London, Swan, Sonnenschein & Co.; New York, Macmillan & Co., 1892.

Wallace and Poulton, are well taken. While he is far from denying the efficacy of that process, he does not trace to it the origin of characters, and he presents various instances where the latter seem to have been the consequence of the direct action of physical causes. His investigations are especially valuable because they cover a field which has been especially cultivated by the advocates of the exclusive efficiency of natural selection, and he thus throws new light on the class of facts where the evidence for natural selection is strongest. For this reason the work will well repay perusal, as it serves as a corrective to thought which has, in the opinion of many, gone to an extreme in one direction.

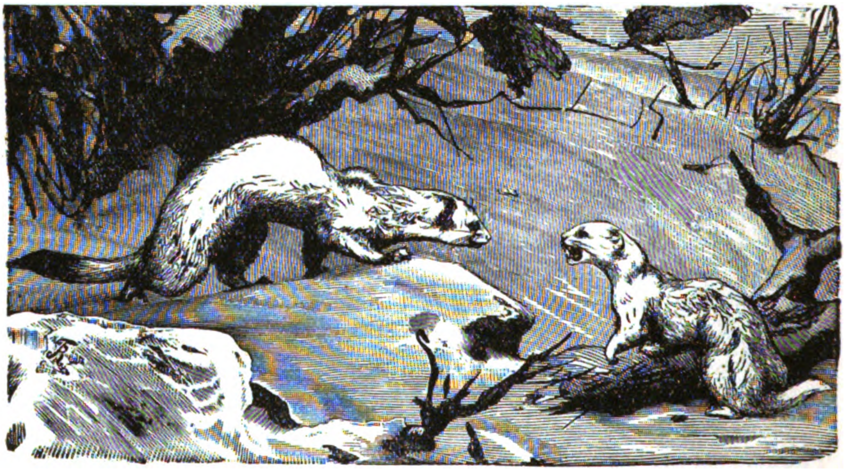


FIG. 1. The Stoat in winter pelage, or Ermine.

The author cites the following remarkable example of the direct effect of physical causes in producing changes of coloration :

" That the yellow color of canaries can be altered to an orange red by mixing cayenne pepper with their food has been known for a long time. This curious fact was first discovered in England, as was also the fact that the different races of canaries vary in their susceptibility to the action of the pepper; some kinds are more, others are less affected, while one race is absolutely without any power of having its coloration altered by these means. The color change is produced by feeding the newly hatched young with the pepper conveyed in their food or the old birds while sitting upon the nest are furnished with food containing the cayenne, which they in turn feed their offspring. The color change can, in fact, be only brought about in very young birds whose feathers are not completely matured; it is quite impossible to produce any alteration upon the full grown canary. Clearly, therefore, here is an instance of the direct effect of food upon color. An interesting paper upon the subject, which has also furnished me with the facts already mentioned,[2] and it will be of interest to give some account of the author's (Dr. Sauermann's) experiments for reasons that will appear. Cayenne pepper, of course, is a composite substance, from which a number of distinct chemical substances can be extracted; the red color is caused by a pigment termed capsicin, which can be separated from the pepper; and it might easily be supposed that the change from yellow to red in the feathers of the canary was simply caused by a transference of the pigment, as in the cases mentioned on p. 127; but Dr. Sauermann shows that it is not so. Yellow colored canaries were not in the very slightest degree affected by the pigment alone; but, curiously enough, parti-colored birds did react—the brown parts of the feathers became distinctly lighter in hue. It is a fatty substance (triolein) which appears to convey the pigment and produce thus a changing of the color from yellow to red; and further experiments were made with other birds, showing that it is not only canaries which are influenced by their food in this way. Some white fowls, belonging to a special breed, showed traces of yellow among the feathers after feeding with cayenne; but in this case these were not racial, but individual differences in susceptibility, for all the specimens of birds experimented with did not react to the stimulus.

"A similar series of experiments was made with some other colors; it was found with carmine that the yellow color was destroyed and the birds became white. This unexpected effect is explained by the fact that a mixture of violet and yellow produces white. The fact that the fatty constituent, triolein, plays the chief part in the coloring of the feathers may perhaps help to explain the very singular fact that the Amazon parrots change from green to yellow when fed upon the fat of certain fishes.

"With regard to the white fowls referred to, the experiments made by Dr. Sauermann were particularly interesting. The interest lies in the fact that the pigment was not absorbed equally by all the feathers; only special tracts were affected; the breast feathers, for instance, became red, while the head remained white. It is therefore quite credible that in a state of nature partial alteration of color may be produced by a change of diet."

---

[2] Archiv. Anatomie und Physiol., 1889. Physiol., Abtheil., 543.

In a chapter relating to protective resemblances will be found an account of several examples of animals which have apparently acquired a resemblance to their surroundings by the transference of pigment to their bodies in their food.

The list of illustrations comprises four very attractive colored plates and thirty-six wood cuts, each of which repay study.

We reproduce three of these; one that represents color harmony with the environment in the winter pelage of the stoats; and two showing similar feather developments in the tails of the Polytmus humming bird and of the Argus pheasant, in America and Asia respectively.

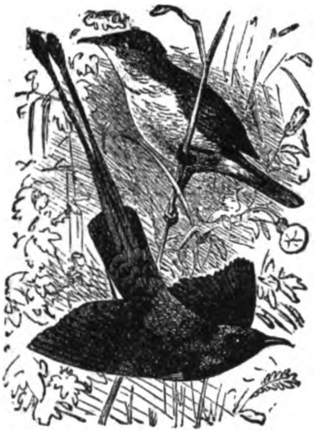


FIG. 2.
The Polytmus humming bird; lower figure the male; the upper the female.

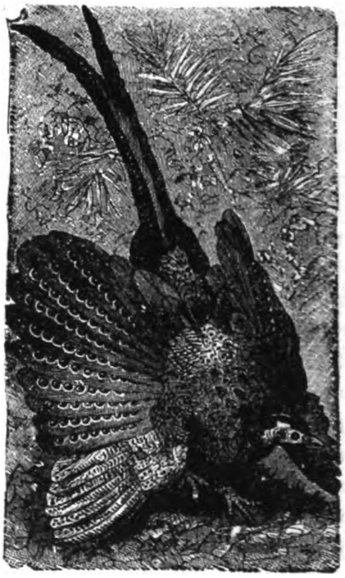


FIG. 3.
The male argus pheasant.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Currents of the North Atlantic.—Prince Albert, of Monaco, has recently published a chart of the currents of the North Atlantic, entirely based upon the results of a series of experiments he has been conducting since 1885. In that year he launched 160 floats at intervals, along a line of 170 miles, in the direction of N. 14° W. from a point 110 miles northwest from Cowo, one of the Azores. The following year 510 floats were launched, nearly in the meridian 17° 40′ west of Greenwich, between 42° 34′ and 50° N. latitude. In 1887, 931 floats were launched along a line extending from the Azores to the Grand Banks, of Newfoundland. During the same year, a group of floats was launched between two other points in the North Atlantic, between the Azores and Newfoundland.

Of the floats thus launched, 227 were sent back to the experimenter with detailed information as to the place and date of finding. These several histories gave indications of the direction and speed of the currents which floated them. The internal edge of the great vortex performs a revolution with a very short radius round a point south-west of the Azores, and not very distant from them. The cycle described by objects drawn into the vortex is renewed indefinitely, except in the case where they escape by an offshoot into the Arctic regions.

The mean velocity for the region comprised between the Azores, Ireland, and Norway is 3.97 nautical miles in 24 hours; between the Azores, France, Portugal, and the Canaries it is 5.18 nautical miles in 24 hours. From the Canaries to the West Indies, the Bahamas, and even to Bermuda, it attains 10.11 nautical miles in 24 hours. In the eastern portion of the arc, which extends from Bermuda to the Azores, it falls again to 6.42 nautical miles in 24 hours. The mean velocity is 4.48 nautical miles in 24 hours. (Proceeds. Roy. Geog. Soc., Sept., 1892.)

Fins of Palæaspis Americana.—Mr. Claypole has recently published the description of certain objects which he believes to be the fins of *Palæaspis americana.* This fossil Mr. Claypole at first supposed to be a spine, but upon examination it was found to be margined with a flat fringe around the pointed end and the rounded conical parts were filled with matrix; this central spine-like portion is covered with a layer of the same tissue as that of which the shield is composed; the fringe around the conical central portion is distinctly striate in a direction approximately parallel to its axis. These points of resemblance to a Crossopterygian fin, together with the fact that one of the specimens was found so close to the side of the dorsal shield as to irresistibly suggest a connection, have decided Mr. Claypole to add the character of a fin to his amended definition of *Palæaspis americana.* (Quart. Journ. Geol. Sur. 1892.)

New Reptiles from the Elgin Sandstone.—We have already noticed the reptilian remains from the Elgin Sandstone, which are in the condition of hollow moulds, the bones themselves having entirely disappeared. Casts of these moulds have been made of gutta-percha, which upon examination prove to be models of eight distinct skeletons, of seven species of remarkable reptiles new to science. Professor E. T. Newton, to whom the casts were sent for identification, refers 5 of them to the genus *Gordonia*; *G. traquairi* (2), *G. huxleyana*, *G. duffiana* and *G. juddiana.* In *Gordonia*, as in *Dicynodon*, the maxilla is directed downward and forward to end in a small tusk. The former is distinguished from the latter by the presence of two post-temporal fossæ on each side of the occiput, by the small size of the maxillary tusk, and by the slight ossification of the vertebral centra. A second generic form, *Geikia elginensis* is nearly allied to *Lystrosaurus* Cope, but is distinguished by its shorter muzzle and the entire absence of teeth. The maxilla is produced into a tooth-like prominence, which occupies a similar position to the tusks of *Gordonia.* For the remaining species, Mr. Newton proposes the name *Elginia mirabilis.* The exterior of the skull is covered in by bony plates, the only apertures being the pair of nostrils, the orbits, and the pineal fossa. Horns and spines, varying from ½ inch to 3 inches in length are found upon nearly every bone of the exterior. This feature reminds one of the living lizards *Moloch* and *Phrynosoma.* With the exception of a smaller number of teeth, the dentition is a repetition on a large scale of *Iguana.* This peculiar skull seems to show affinities with both Stegocephali and Lacertilians, and is unlike any living or fossil form; its nearest, though distant ally apparently being the *Pariasaurus* from the Karoo beds of South Africa. (Nature, Dec., 1892.)

Fossil Reptiles from the Parana.—In the Boletin of the Academia Nacional de Ciencias of Cordova (Argentina), Mr. Juan B.

Ambrosetti describes three new species of fossil reptiles from the Oligocene of the Parana. He also descrbies more fully three other species already named by Bravard, Burmeister, and Scalabrini. The entire number are referred to five genera, of which four are reported to be new. The descriptions of species are quite full, but the new genera are not described at all, so that they have, so far, no scientific standing. One of them is said to be near to Tupinambis ("Podinema"), and the others are crocodiles. Three of them are regarded as near to the gavials, and are an interesting addition to the South American fauna, if this statement is confirmed. But the author is not yet fully competent for the task he has undertaken. He writes of the "Ameividæ," meaning Teidæ, and imagines that Rhamphostoma was proposed by Burmeister in the Annals of the Museum of Buenos Ayres! His knowledge of classic composition is indicated by his construction of the abortion Oxysdonsaurus, of which an American grammar school boy would not have been guilty. He should have written Oxyodontosaurus, a very awkward name at best. As the genus is not defined, however, nobody is under obligation to adopt it.—E. D. C.

On the Systematic Position of the genus Protogonodon.—The collection of fossil mammalia in the American Museum from the Puerco formation contains among the numerous specimens a few upper teeth, and a number of lower jaws belonging to the genus *Protogonodon*, Scott[1] (-*Mioclænus* Cope, in part). I consider the material referable to the genus *Protogonodon* as the most important in this collection, as it enables me to probably settle the question as to its phylogentic position in the system.

Professor Cope's type of *Protogonodon* is a lower jaw with teeth. In his description[2] of this specimen, he considered it as probably closely related to the Condylarthra, but as he was not familiar with the upper molars, he placed it in the rather indefinite genus *Mioclænus*. Later Professor Scott[3] in his valuable paper on the Creodonta removed the *M. pentacus* from *Mioclænus*, and established the genus *Protogonodon* for its reception. Professor Scott places this genus among the Condylarthra, and probably in the family *Phenacodontidæ*.

The series of upper molars in the collection which I refer to Protogonodon were not found associated with lower teeth, so that their reference to this genus is not absolutely certain. However, as the lower true molars of *Protogonodon* are of the sextubercular type, I believe they should be associated with a superior molar which is tritubercular. These upper molars consist of three principal cones with well developed intermediate tubercles; the external cones differ considerably in form from those of the Creodonta (*Sarcothraustes*), but the general form of the upper true molars in *Protogonodon* closely resembles that of the Creodonts.

---

[1] Proc. Philad. Academy, 1892, p. 322.

[2] Synopsis of the Vertebrate fauna of the Puerco series, 1888.

[3] Op. cit.

Another character of the teeth of *Protogonodon* which differentiates it from the Perissodactyle line is the character of the inferior premolars. The last tooth of this series is much simpler in structure than in *Protogonia*, and closely resembles that of *Pantolestes*. It consists of a simple cone with a slightly enlarged heel. In *Protogonia puercensis* on the other hand, a well marked deuterocone is present, and this tooth is nearly as complex as it is in *Phenacodus*.

I believe from these characters of the teeth, and also from the fact that the lower jaw is elongated and slender, as in the genus *Pantolestes*, that *Protogonodon* should be placed near the latter genus, and may stand in ancestral relation to it.

Unfortunately the foot structure of *Protogonodon* is totally unknown, so until that is discovered we cannot decide its affinity with certainty.

It is of great interest to note, if my supposition be correct, that in the genus *Protogonodon* we are dealing with an ancestral Artiodactyle, and that already as far down as the lowermost Eocene (Puerco) the main types of the Ungulata were differentiated. It will not then be necessary to resort as Schlosser has done to derive the Artiodactyla from any of the known Periptychidæ, but that the Perissodactyla were represented by *Protogonia*,[4] the Artiodactyla by at least *Protogonodon* and perhaps other genera, as suggested by Professor Scott. Lastly as Professor Cope has shown the *Amblypoda* were already evolved and represented by the genus *Pantolambda*.

Whether or not these Ungulate stems were in all cases distinct from the Condylarthra, remains for future research to prove; but at least one of them, the Amblypoda, was differentiated. In the case of Protogonodon the structure of its teeth shows that it was fairly well on the Artiodactyle line, but the discovery of its foot structure will demonstrate whether or not it had passed the Condylarthrous stage.

I believe that among the Puerco Condylarthra that *Protogonia* was a persistent type, and nearly all of the Periptychidæ with the possible exception of *Mioclænus turgidus* died out and left no descendants.—CHAS. EARLE.

---

[4] Professor Cope informs me by letter that the name *Protogonia* is preoccupied, and he proposes as a substitute the name *Euprotogonia*.

American Museum of Natural History, New York.

The Brown Coal and Lignite of Texas.[5]—Mr. E. T. Dumble's comprehensive report on the fossil fuel supply of Texas has been issued as a separate publication by the Geological Survey of that State. In the course of his investigations, Mr. Dumble found it necessary to visit the mines and factories of Austria and Germany, where by personal observation he ascertained the character, use, and value of lignites, together with the best methods of utilizing this fossil wealth. His report is complete, both from a geological and an economic standpoint. Geologically, he describes the origin, formation, physical and chemical character, and the occurrence of the brown coal. Incidentally a classification of the Texas brown coals is given. As an economist, Mr. Dumble suggests the particular uses to which the varieties of brown coal may be put, discusses the valuable products that may be obtained from it, and gives in detail the most approved methods of making it into artificial fuel by brignetting. In a word, Mr. Dumble has demonstrated that in her brown coals and lignite, Texas has an abundant and cheap fuel supply.

The text is illustrated with a number of cuts of machinery, and an excellent map.

Extinct Fauna of Mauritius.—At the meeting of the Zoological Society, of London, Nov. 1, 1892, a communication was read from Sir Edward Newton and Dr. Gadow, describing a collection of bones of the dodo and other extinct birds of Mauritius, recovered from the Mare aux Songes in that island by the exertions of Mr. Theodore Sauzier. The collection contained examples of the atlas, metacarpals, prepelvic vertebræ and complete pubic bones of the dodo, which have heretofore been wanting, as well as additional bones of Lophopsittacus, Aphanapteryx and other forms previously known to have inhabited that island. Besides these there were bones of other birds, the existence of which was not before suspected, and these were described as belonging to the genera Strix, Astur, Butorides, Plotus, Sarcidiornis, and Anas.

---

[5] Report of the Brown Coal and Lignite of Texas. Character, Formation, Occurrence and Fuel Uses. By E. T. Dumble, F. G. S. A., State Geologist.

MINERALOGY AND PETROGRAPHY.[1]

Description of the New Rock Type, Malchite.—The new rock, malchite, referred[2] to a few months ago as the granitic dyke form of diorite, is now described in some detail by its discoverer, Osann.[3] It forms dykes cutting granite in the Odenwald, Germany. In a dense groundmass are rare phenocrysts of dark mica, pale green plagioclase and quartz. The mica is biotite and the plagioclase labradorite. In addition to these the microscope reveals the presence of idiomorphic green hornblende, allanite and sphene. The groundmass in which these lie strongly resembles that of some tinguaites, with hornblende and quartz in place of aegerine and nepheline. It consists of a fine granular aggregate of feldspar and quartz, the latter with occasional idiomorphic contours, and prisms of hornblende imbedded in the aggregate, the prisms often arranged in flowage lines. An analysis of a fresh specimen of the rock yielded:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	SO_4	P_2O_5	Total
63.18	17.03	.24	6.37	.92	4.17	4.44	2.91	.52	.19	.23	=100.20

The Petrography of Hokkaido, Japan.—In a general geological sketch of Hokkaido, (Jezo or Yesso), Japan, Jimbo[4] declares that the island consists largely of paleozoic beds, probably underlain by amphibolites and various other schists, and cut by granite, diorite, gabbro, peridotite, and serpentine. In the lower portion of the paleozoic the beds consist largely of pyroxenites, with traces of radiolarian remains, phyllites, quartz-schists, limestone, and serpentine. The pyroxenites are aggregates of light colored augite, quartz and feldspar, in which the augite is often more or less changed to epidote and glaucophane. Where the granite cuts the clastics the clay slate is changed by contact action to a biotitic clay slate, to hornfels and to mica schist, with the latter nearest the eruptive. Tourmaline occurs in the schist and cordierite in this rock and in the mica slate. An amphibolite in the contact belt is supposed to be an altered tufa. Schistose granites, diorites and gabbro are phases of the corresponding cks associated with the contact products. Diabases occur as ne unaltered paleozoic beds, and serpentines derived from id from dunites are met with cutting these at various locali- addition to paleozoic there are also tertiary rocks on the l these are cut by their own systems of dykes and bosses, and edded with characteristic sheets of lava, and layers of tufas. ry volcanic rocks are pyroxene and hornblende andesites, and rhyolites. The pyroxene andesites contain both ortho- and monoclinic pyroxenes and occasionally some olivine. also a glassy base which sometimes becomes so abundant as le pumice. The hornblende andesite is strongly porphy- large phenocrysts of hornblende. The rhyolites are both nd glassy, in which latter case they are vesicular.

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] AMERICAN NATURALIST, May, 1892, p. 422.

[3] Mitth. Gross. Bad. geol., Landesanst ii, p. 380.

[4] General Geological sketch of Hokkaido, with special reference to the petrography. Satporo, Hokkaido, Japan, 1892.

Peculiar Rocks from Siberia.—Two very remarkable described by von Chrustschoff[5] from Taimyr-Land, Siberia. ophitic aggregate of anorthoclase and nosean, containing as sanidine, plagioclase, amphibole, biotite, melanite, magne- e, zircon and glass. The anorthoclase is in long, narrow f the following composition:

O_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Total
59	19.84	2.24	1.26	.63	3.53	7.88=	99.97

ding to Or_2, Ab_6, An_1. The feldspar is usually idiomorphic ect to the nosean, whose period of formation was between ne biotite and that of the hornblende. The nosean is in very ntity. Its density is 2.266 and composition:

l_2O_3	Fe_2O_3	Na_2O	K_2O	CaO	H_2O	Cl	SO_3	Total
6.59	.38	22.40	1.63	.54	.87	1.66	8.68 =	99.98

con is of the trachytic type, and is the only accessory of any ce. The author calls the rock taimyrite. The second rock ed of anorthoclase, sanidine, biotite, and amphibole as essen- onents, and the other minerals mentioned above in connec- taimyrite as accessories, except that sodalite here replaces The zircon is of the granitic type, and the rock possesses the exture.

---

l'Acad. Imp. des Sciences St. Petersb. Mél. Geol. et Paleont., i, p. 153.

An Ottrelite Bearing Conglomerate in Vermont.—It is not uncommon to find ottrelite forming 25% of the schistose groundmass of the conglomerate[6] at the base of the Lower Cambrian, near Rutland, Vermont. The same mineral occurs along shear planes in a blue quartzite and constitutes 40% of a massive bed of the conglomerate. In the last named rock the ottrelite is in rudely circular areas, lying in a dark colored quartz. The areas consist usually of radiating plates of the mineral, disposed in a single plane. Its commonest inclusions are quartz and feldspar, while sericite often forms the centers of the radiating bundles. In the latter case the ottrelite is oriented in parallel position with the mica. Other inclusions within the ottrelite besides those above mentioned are crystals of zircon and rutile, flakes of graphite and plates of ilmenite. In other cases the ottrelite is in plates including large areas of the groundmass of the rock, which is a granulated mixture of quartz and albite (?) in about equal proportions, a large quantity of sericite, and some biotite. In this groundmass associated with rutile are crystals and plates of anatase. No traces of its original clastic structure remain in the rock, though its conglomeratic character is beyond dispute.

Lithophysæ in the Rocche-Rosse.—In parts of the Rocche-Rosse lava stream of Monte Pelato, Lipari, are spherulites with lithophysal characteristics. In some specimens examined by Cole and Butler[7] the spherulitic growth originated about the walls of steam vesicles, and progressed outward into the rock; in other cases they grew inward until they have completely filled the space that was formerly vacant. The importance of the paper lies in the fact that it acknowledges the correctness of many of Idding's views with respect to the formation of lithophysæ, and contradicts the view that regards all hollow lithophysæ as the result of the decomposition of spherulites.

The Composition of the Dune Sands of the Netherlands.—A very elaborate paper by Retgers[8] on the constitution of sand composing the dunes on the west coast of Holland at Sheveningen, near the Hague, contains a large amount of information concerning the character of sands and the method of determining the nature of their constituents. The author carefully fractioned large quantities of the dune sand by the ordinary methods of fractional precipitation in the usual heavy liquids and by means of the molten substances suggested by himself[9] for this purpose a few years ago, thus obtaining mixtures of mineral grains of about the same density. These then were studied carefully by comparison of their indices of refraction, by immersing them in liquids of known optical densities, until one was found in which the grains became almost invisible. The index of refraction of these is nearly that of the liquid, consequently their nature is thus approximately determined. Microchemical tests and the ease with which cleavage laminæ were produced, served to distinguish accurately between minerals having nearly the same refractive index. The principal minerals identified by the author are orthoclase, quartz, microline, plagioclase, cordierite, calcite, apatite, amphibole, tourmaline, pyroxene, epidote, sphene, sillimanite, olivine, garnet, staurolite, disthene, corundum, spinel, rutile, zircon, magnetite and ilmenite. The surprising discoveries are those of cordierite, calcite and olivine, and of glaucophane among the amphiboles. The proportions of the various minerals present according to specific gravity was 2.5% between 2.5 and 2.6; 85% between 2.6 and 2.7; 7.5% between 2.7 and 3. ; 1.5% between 3 and 3.3; 1% between 3.3 and 3.6; 2.4% between 3.6 and 4.2; .1% between 4.2 and 5.2. The sands are supposed to have come mainly from the rocks of archean terraces.

---

[6] C. L. Whittle, Amer. Jour. Sci., Oct., 1892, p. 270.

[7] Quart. Jour. Geol. Soc., xlviii, 1892, p. 438.

[8] Recueil des Travaux Chimiques des Pays-Bas., xi, 1892, p. 169.

Quartz-Gabbro in Maryland.—In the Baltimore gabbro area, according to Grant,[10] are quartz gabbros consisting of bytownnite, quartz, hypersthene, secondary hornblende, and a few accessories. The quartz is limpid, and is almost free from inclusions, except for lines of small liquid cavities that traverse the grains, as is usual in granitic quartz. Diallage, which is so common in the normal gabbro of the region, is entirely absent from the quartz-bearing phases, which thus becomes a quartz norite.

Minerals from the Diamond Fields of Brazil.—Hussak[11] describes the characteristics of crystals of brookite, cassiterite and xenotime from the diamond region of Dattas, Minas Geraes, Brazil. On *brookite* from the sands of Diamantina was found the new pyramid, $\frac{1}{2}P\breve{2}$. The *cassiterite* is from Manquinho, near São Paulo. It occurs in a rubellite-bearing lepidolite granite. The *xenotime* accompanies the brookite in the sands of Dattas. On one doubly terminated crystal were found the two new pyramids $\frac{4}{7}P$ and $\frac{1}{5}P$. The axial ratio of these crystals is 1 : .61775. The author has also made a crystallographic examination of the *monazite* occurring so abundantly in the Brazilian granites and gneisses. The crystals of this substance are always tabular parallel to $\infty P\bar{\infty}$. They contain the same forms as do the Ilmengebirge crystals, but are never twinned. Upon washing a portion of sand from Bohia a 3 mm. long crystal of *euclase* was obtained whose density is 3.1. It is very rich in planes, being possessed of not less than three prisms, six clinodomes and three negative pyramids, beside the clinopinacoid.

---

[9] Cf., AMER. NATURALIST, 1890, p. 175.

[10] Johns Hopkins Univ. Circ. No. 103.

[11] Min. u. Petrog., Mitth. xii, p. 455.

Mineralogical Notes.—*Christianite* crystals are reported by Gonnard[12] as lining geode cavities in the basalts of dykes at Queyrières and Fay le Froid, Haute Loire, France. In the latter case the christianite groups enclose many crystals of augite. The trachyte of Montcharet, occurring as a dyke in granite, is cut by fissures whose walls are lined by *chabasite.*[13] The cubic faces of *galena* crystals implanted in druses of quartz at Pontgibaud are roughened by little cavities whose walls have the positions of octahedral planes. The phenomenon is regarded by Gonnard[14] as the result of corrosion. The same author mentions the existence of large crystals of *beryl* in the granites of Droiturier, near La Palisse, Allier, *psilomelane* in mammillary forms at Croix Moraud, Mt. Doré, and cubic pseudomorphs of *quartz* after some unknown mineral, probably fluorite, in the vicinity of d'Aubenas, Ardèche.

Three specimens of *melilite* from Mt. Somma, with densities of 2.917, 2.932 and 2.945 respectively, were powdered, purified, and analyzed by Bodländer[15] with this result:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total
41.34	10.37	4.29	33.84	5.79	1.13	3.45	.08 =	100.29

The author combats the view of Vogt that melilite is an isomorphous mixture of the gehlenite and akermanite molecules. He thinks that the negative variety is an admixture of $R''SiO_3$ and the aluminate R'''_2O_4R'', while the positive variety is a compound of the same silicate with the aluminate $R_2'''O_6R_3''$. Intermediate varieties are isomorphous mixtures of these.

---

[12] Bull. Soc. Franç d. Min., 1892, xv, p. 28.

[13] Ib., p. 31.

[14] Ib., p. 34.

[15] Neues. Jahrb. f. Min., etc., 1893, i, p. 15.

ecords the analysis of a granular *nickel arsenide* associated e silver and siderite in a mine 18 miles west of Silver City, The silver is imbedded in arborescent forms in the brittle l ore, and this in turn is in a gangue of siderite. The ade on impure substance gave:

SiO_2	Pb	Ag	As	Ni	Co	Fe	Total
4.56	tr.	8.38	67.37	11.12	5.13	2.64 =	99.20

the SiO_2 and Ag as impurities the composition takes a form e represented by RAs_3 in which R = $\frac{4}{7}$ Ni $\frac{2}{7}$ Co and $\frac{1}{7}$ Fe, ing to a *nickel skutterudite.*

tals of topaz from the Province of Omi and from the tin enagari Mino, Japan, Matthew[17] finds four pyramids, seven e of which, $\infty \breve{P} \frac{11}{4}$, is new, the three pinacoids, three brachy- two macrodomes.

l Anomalies.—After an exceedingly careful examination ctions of appophyllite crystals and a comparison of the phe- ey present with those presented by combinations of thin tes placed one upon the other, Klein[18] concludes that the its geometrically tetragonal crystals is an intimate mixture y positive and optically negative triclinic lamellæ. The nstituent seems to differ from the negative element in con- crystal water, since upon heating the positive component increase in quantity. Negative appophyllite becomes posi- loss of 4½ molecules of crystal water. The investigation is l piece of accurate optical work.

ply to Mallard's[19] remarks on the black garnet pyrenaite tates that the structure described by the first mentioned xactly what should be expected of a dodecahedral substance in, and that the peculiarities of this garnet's optical proper- e easily explained on the Klein-Brauns theory of strain.

oaking in oil sections of zeolites that have been rendered loss of water, they again become sufficiently transparent for of their optical properties. Rinne[21] has taken advantage of

---

f Mines Quart., xiv, No. i, p. 49.

No. 1, p. 53.

ahrb. f. Min., etc., 1892, II, p. 165.

AN NATURALIST, Oct., 1892, p. 849.

ahrb. f. Min., etc., 1892, I, p. 217.

ues. Jahrb. f. Min., etc., 1892, II, p. 237.

this phenomenon and has carefully examined a number of the members of the group with a view to learning something of the changes effected in them by the loss of water. *Natrolite* appears monoclinic under these conditions, *scolecite* orthorhombic, *stilbite* orthorhombic, and each of the other zeolites affords a corresponding meta-zeolite. The optical anomalies often observed in these minerals is thought to be undoubtedly due to partial loss of water.

Isomorphism.—After a long mathematical discussion of the theory of the structure of isomorphous mixtures and upon comparison of the results of investigations upon the optical properties of mixed crystals, Poeckel[22] concludes that we have not yet sufficient data to decide as to whether Mallard's lamellæ theory of the constitution of these bodies is correct or not.

By the use of the method[23] in which colored and colorless crystals of supposed isomorphous substances are allowed to form under the microscope Retgers[24] has proven that the alkaline ferrates are isomorphous with the corresponding sulphates, selenates, molybdates and tungstates, that the potassium tellurates and osmiates are isodimorphous, and that the rutheniate of this metal is isomorphous with its uranate.

The arguments for and against the view as to the isomorphism of calcite and dolomite are given respectively by Brauns and Retgers[25] in a recent letter to the Neues, Jahrbuch. The discussion is too involved to warrant an intelligible abstract in these notes.

Etched Figures.—The matrix of the African diamonds is capable of resorbing[26] *diamonds*, producing on their faces irregular, long, and hemispherical hollows, associated with which are little spheres and grains of black carbonaceous substance, supposed to be a compound of iron and carbon.

Hofer[27] describes corrosian forms on the *calcites* of Steierdorf, Banat, and of Rauris and Salzburg, and ascribes the hexoctahedral faces $\frac{24}{5}$O2 on the *fluorite* of Sarnthal, Tyrol, to corrosive processes.

---

[22] Neues. Jahrb. f. Min., etc., B. B., viii, 1892, p. 117.

[23] AMERICAN NATURALIST, June, 1892, p. 517.

[24] Zeits. f. Physik. Chem., x, 5, 1892, p. 529.

[25] Neues. Jahrb. f. Min., etc., 1892, II, p. 210.

[26] Ber. deutsch. chem. Ges., 1892, p. 2470.

[27] Min. u. Petrog., Mitth. xii, p. 487.

Microchemical Reactions.—The methods of testing for traces of ammonia under the microscope, and of precipitating metals with H_2S are described in a few words by Streng.[28]

Directions for the detection of the following minerals in small particles are given by Lemberg:[29] *Scapolite, hauyne, sodalite, eudialite, lasurite, sulphur, olivenite, celestite and melilite.*

Miscellaneous.—Under the title "Rapid Qualitative Examination of Mineral Substances," Moses and Wells[30] publish a scheme for the detection of minerals. The blowpipe method is used with the metallic minerals, but in the silicate group a mixture of the dry and wet methods is made use of. From a hasty reading of the scheme it seems to be a practicable and convenient one.

---

[28] Neues. Jahrb., 1893, I, p. 49.

[29] Zeits. d. deutsch. geol. Ges., 1892, p. 224.

[30] School of Mines Quart., Nov., 1892, p. 25.

ZOOLOGY.

The German Zoological Society.—The annual report of this society for 1892 is out, and contains among others the following papers: The opening address by the President, Professor F. E. Schultze, described the zoological department of the University of Berlin, where the meeting was held, giving also a sketch of its history. Professor H. E. Ziegler spoke upon the embryonal anlage of the blood in the vertebrates. At first the blood is a clear serum in which no corpuscles appear. Later they are present. Various ideas have been advanced as to their origin. Ziegler vigorously discusses the view which assigns them to the entoderm and decides that they are without doubt mesodermal in origin. Dr. L. Plate described the anatomy and affinities of the Onchidiidæ. These forms belong to the Asiatic region, and are amphibious, living equally well in or out of the salt water. To separate the genera the author uses the relative width of the foot and of that suprapedal region to which he gives the name of hyponotum. The group is of great interest from the fact that though usually regarded as Opisthobranchs they must be considered as near the ancestral Pulmonate. Plate, however, thinks that they have crossed the line and are true Pulmonates, but that their Nudibranch characters are such as cannot be explained except upon the hypothesis of descent from that group. Dr. Thiele, in discussing the phylogeny of the byssus apparatus of the Lamellibranchs, thinks that it must be traced back to some such type as the adhesive glands of Haliotis, and does not agree with Pelseneer in regarding the byssal glands of the Nuculidæ as the most primitive. The fact that either in young or in adult the byssus occurs in most Acephals, is proof to Thiele that the gland must be traced back to the ancestral mollusc. Von Nathusius discussed the form and color of the hair as a basis of classification of the Equidæ. Dr. Korschelt presented a paper on the differentiation of the germ-layers in the Cephalopods with especial reference to the formation of the alimentary canal and the nervous system. According to Bobretzky both the midgut and the nervous system are of mesodermal origin, while several other authors think that the whole alimentary canal is formed by ectodermal inpushings (stomo- and proctodeum). Korschelt finds[1] that at an early date an epithelial layer arises just above the yolk in the anal region. It is distinctly separated from the ectoderm by the mesoderm. Later it becomes elevated from the yolk, forming a small cavity open to the yolk, the future mesenteron. This layer is regarded by Korschelt as entoderm, and has been regarded by several authors as the proctodeal inpushing. He also finds the nervous system to be, as might have been expected, ectodermal. Dr. Burckhardt described the central nervous system of the Dipnoi. He has subjected the brain to sections, and by study of these has been able to elucidate points not before understood. He concludes that in its brain Protopterus is not an Amphibian, but that it is in this respect a problematic organism between the fishes (Elasmobranchs) and Amphibia, whose exact position will first be solved when the ontogeny is studied. Professor R. Hertwig had a review of recent work upon canjugation and fertilization, and Dr. H. H. Field a paper on the Metamerism of the Kidney of Amphiuma, already noticed in our pages. The last paper was a view of the idea of instinct, by Professor H. E. Ziegler.

---

[1] The full paper with illustrations appears in the Leuckart Festschrift.

Eyes of Polychætes.—Dr. E. A. Andrews has an extended article[2] on this subject. He has studied a large series of genera, some both as young and adult, and among the conclusions at which he arrives are the following: The eye is an epidermal organ consisting of a pigmented cup containing a refracting mass, which at the orifice of the cup comes in contact with the cuticle. The wall of the cup consists of a single layer of cells forming the retina, each retinal element containing pigment, and being produced internally into a nerve process, externally into a clear rod. This, as will be seen, is a different conception of the annelid eye from either that of Carrière or that of Graber, but one which approaches most nearly to that of the former author.

Arachnida.—Mr. B. I. Pocock discusses[3] the external anatomy of the members of the group Arachnida (*s. s.*), and concludes that the members must be arranged in two sub-classes, Ctenophora, with the single order Scorpiones, and Lipoctena, containing the superorders Caulogastra (Pedipalpi and Araneæ) Mycetophora (Solifugæ), and Holostomata (Pseudoscorpiones, Opiliones, Acari).

F. Purcell, after studying the anatomy and development of the eyes of *Liobunum hemisphæricum*, concludes[4] that contrary to the commonly accepted ideas, these organs in the Phalangids are to be regarded as compound, and further that they are inverse eyes homologous with the anterior middle eyes of spiders and the middle eyes of the scorpions.

---

[2] Jour. Morph., vii, 169, 1892.

[3] Ann. and Mag. Nat. Hist., VI, xi, p. 1, 1893.

[4] Zool. Anz., xv, 1892.

The Fishes of the Pacific Coast of America North of Cerros Islands.—An important paper recently published is an enumeration of the fishes occurring on the Pacific coast of America north of Cerros Island, and to a depth of 150 fathoms by C. H. and R. S. Eigenmann. The authors have placed the dividing line between the littoral and the bathybial faunas of this region at 150 fathoms, because all of the genera so far recorded from this depth have representatives in the shallower water. The few littoral genera which have representatives in deeper water are added as footnotes. Cerros Island is a natural boundary to this region, since south of it few of the characteristic genera of this region are found. The author's observations show that the old division, at Point Conception, of the northern and southern California fauna is incorrect, and that, in reality, no definite boundaries can be assigned for a northern and southern fauna.

The California fauna is distinct from that of Alaska, although four of the species found at San Diego are found in Alaska. The California Fauna is characterized by the abundance of species of Sebastodes, of Cottidæ, and of Embiotocidæ. The last are entirely absent from Alaska, and only a few species of Sebastodes are found there. The boundary between these two regions lies somewhere between Sitka and Puget Sound.

The relative number of species at the principal localities is as follows:

	Species.
The whole of Alaska	108
Puget Sound	107
San Francisco	156
Monterey	148
Santa Barbara	117
San Pedro	82
San Diego, including Cortes Banks	168

There are known from the entire region 382 species, belonging to 228 genera. Of these 116 genera, or more than half, are also found in the Atlantic Ocean, and 32 species are found both in the Atlantic and in the Pacific.

The genera having species in both oceans practically all belong to one of three classes: 1st, Tropical genera; 2d, Arctic genera; 3d, Pelagic and other genera (Ann. N. Y. Acad. Sci., vi, 1892).

On the Mechanical Genesis of the Scales of Fishes.—Mr. J. A. Ryder has advanced a theory that the genesis and arrangement of the scales of fishes is due to the movements of the fishes in swimming. The scales originate in a continuous subepidermal matrix which may be regarded as a basement membrane. Such a matrix is found to actually exist in some forms at an early stage, just beneath the epidermis; in other forms it exists in the larval stages, and in the young of many types of fishes it is coextensive with the whole epidermal layer just at the time when the scales are forming.

In the Clupeoids and Cyprinoids it is found that the myocommata, or sheets of connective tissue intervening between successive somites are attached firmly to the deeper layers of the skin. This construction, together with the peculiar arrangement of the muscle plates at the time the scales begin to form, conditions the further growth of the scale matrix. The ordinary movements of the fish in swimming throw the whole integument into definitely circumscribed areolæ, of which the central portions are in a quiescent state, while the margins are wrinkled or folded as a result of the current action of the lateral muscles of the body.

In each of the circumscribed areolæ a scale develops; the continuity of its development with its fellows across the margins of the areola is prevented by the flexures to which the dermis is there subjected.

The author shows that the imbrication as well as the arrangement of the scales is determined by the action of the segmentally arranged muscles of the body.

Special types of squamation, as those of the eel and the sturgeon, confirm the author's views. In cases where the scales are very fine, that is, several oblique rows corresponding to each somite, the principle holds good, since the rows still conform to the lines of tension of the linear attachment of the myocommata to the integuments.

From the hypothesis and the evidence presented, Mr. Ryder draws the following important conclusion:

1. "The scales of fishes bear a segmental relation to the remaining hard and soft parts, and are either repeated consecutively and in oblique rows corresponding to the number of segments, or they may be repeated in rows as multiples of the somites, or segmental reduction may occur, which may affect the arrangement of the scales so as to

reduce the number of rows below the number of somites indicated by the other soft and hard parts.

2. "The peculiar manner of interdigitation of the muscular somites as indicated by the sigmoid outline of the myocommata, as seen from their outer faces, and the oblique direction of the membranes separating the muscular cones, has developed a mode of insertion of the myocommata upon the corium which has thrown the integument into rhombic areolæ during muscular contraction. These areolæ are in line in three directions, and the folds separating them, particularly at their posterior borders, are inflected in such a manner by muscular tensions, due to the arrangement of muscular cones, as to induce the condition of imbrication so characteristic of the squamation of many fishes."—(Proceeds. Phila. Acad., Part II, 1892.)

The Systematic Position of the Kiwi.—In a paper on the History of the Kiwi, Professor T. Jeffery Parker gives the following conclusion as to the systematic position of this species:

"On the whole it will be seen that the study of the development of the kiwi tends to lessen the gulf between it and ordinary birds, and to show that its ancestors probably possessed many of the more important and distinctive features which characterize the Carinatæ of to-day. The facts clearly indicate that the founder of the Apterygian house had interrupted plumage, functional wings, an ordinary avian tail, a keeled sternum, a double-headed quadrate, lateral optic lobes, and a pecten in the eye; in other words, that the ancestors of the genus were typical flying birds and not bird-like reptiles.

"Of the eight characters enumerated above as separating the Ratitæ from the Carinatæ it will be noticed that the first five are directly connected with the power of flight. We should expect to find such adaptive characters in purely cursorial birds whether they arose from a common stock or sprang separately from early flying birds, and as a matter of fact they occur to a greater or less extent in such flightless birds as the Dodo, Weka, Notornis, etc., which we know have no genetic connection with one another, but have independently acquired the characteristics of flightlessness. I think, therefore, that the possession of the characters referred to by the whole of the Ratitæ is no argument for their common origin.

"The peculiarity of the quadrate has been shown to be a secondary matter, and we have left only the characters of the base of the skull. These certainly form an excellent diagnostic character by which the whole of the Ratitæ are separated from the majority of the Carinatæ, but even here the distinction is not absolute, for the Tinamous approach in many respects more nearly to the Ratitæ than to the rest of the Carinatæ. Still it seems probable that the various genera of Ratitæ must have diverged from the main line of descent at a comparatively early period, though perhaps not earlier than some of the existing orders of Carinatæ. The Penguins, for instance, are far more reptilian in their vertebral column and less typical in the structure of their wings than the Ratitæ. The Ostrich, however, shows the unique and very reptilian character of two claws on the wing, and the very general presence of wing-claws in the group is a distinctly primitive character.

"Leaving the skull, in which the whole group shows primitive characters, and the wing and related parts, in which the resemblances between the genera are largely adaptive, we find the range of variation in the Ratitæ to be very great indeed. Two genera (Apteryx and Dinornis) have a normal four-toed foot; in three others (Cassowary, Emu and Rhea) the hind toe or hallux has disappeared; while in another (Ostrich) only two toes are left. The pelvis of the kiwi and moa is of the simplest avian type, both pubis and ischia being free; in the cassowary and emu the ischium unites with the ilium; in the rhea the ischiæ unite with one another above the intestines—a unique arrangement; in the ostrich the pubes unite to form a symphysis as in most of the higher vertebrates. The feathers have an aftershaft in the emu, cassowary, and moa, none in the ostrich, rhea, or kiwi. In no order of carinate birds do we find such a wide range of variation as this, and when we add to the characters enumerated the extraordinarily aberrant skull and the structure of the egg shell of the Apteryx, the total atrophy of the wings in Dinornis, and even of the shoulder-girdle in some species of the genus, and the striking differences between the sterna, the shoulder-girdle and the wings of the various genera, we are forced to the conclusion that the existing or lately extinct cursorial birds now known to us are divisible into five well-marked orders, each the equivalent of an entire order of Carinatæ. Of these one order contains the ostrich alone, another the rheas, a third the emu and the cassowaries, a fourth the moas, and a fifth the kiwis.

"As to the relation of the kiwi to the other genera it has been shown to be most nearly allied, as far as its skeleton is concerned, to the moa, differing from it, however, in many important respects. It must certainly have been isolated at a very distant period, and as far as we can see, some of its more striking peculiarities are distinctly correlated to its method of feeding. Most nocturnal animals have large eyes suited for taking the utmost advantage of the semi-darkness, but the kiwi, finding its prey by scent alone, has developed an extraordinarily perfect olfactory sense, while at the same time, having no need to keep watch against beasts of prey, its eyes have diminished in size and efficiency to a degree elsewhere unknown in the bird class."—(New Zealand Jour. Sci., March, 1891.)

Mammals from the Galapagos Islands.—The mammals collected by Dr. Baur on the Salisbury Expedition to the Galapagos Islands were sent to Mr. J. A. Allen for identification. The collection numbers 12 specimens, representing 4 species, of which 2 prove to be introduced species of *Mus*. The other species are both new, one a bat, *Atalapha brachyotis*, the other a mouse, *Oryzomys baurii*, closely related to *O. galapagœnsis*. The only other species of mammals thus far reported from the Galapagos Islands are two species of Eared Seals, *Otaria jubata* (Forst.) and *Arctocephalus australis* (Zimm.), which were obtained by the Hassler Expedition. The list of known indigenous species thus numbers only five.—(Bull. Am. Mus. Nat. Hist., Vol. iv.)

EMBRYOLOGY.[1]

Echinoderm Eggs.—Karl Fiedler[2] endeavored to corroborate the work of Roux by experiments made at Naples upon the eggs of three species of sea urchin. At first the method used was that of Roux, piercing the egg with a needle. It was found necessary, however, to use a lancet shaped needle made by hammering out and sharpening the tip of a common needle. Later the method of shaking employed by the Hertwigs and by Boveri was, for the first time, adopted in separating the cleavage cells.

The use of the needle under the microscope was attended with a great many difficulties, increased by the large mortality amongst the few individuals that could be successfully operated upon. After the egg membrane is quickly cut the cells may be individually punctured and destroyed. Such embryos can be kept only in large vessels with algæ.

By this means it was possible to pierce a cell so that some of the contents ran out without destroying its power of cleaving, providing the nucleus remained; but in other cases where the nucleus escaped, even with but little protoplasm, the cell died. In the cases where cleavage continued the diminished cell gave rise to small progeny; thus in the four cell stage two cells were much smaller than the others; in the sixteen cell stage two of the four polar micromeres were plainly smaller than the others; in the blastula one half was less convex than the other; but later the difference seems to have been equalized.

When cells are separated by shaking, the remaining ones may change their shape, becoming more spherical where no longer in contact with other cells, but they retain their normal position much as if the other cells had not been removed. Thus when one of the first two cleavage cells was destroyed there resulted an eight celled stage that was half the normal sixteen celled stage, having half the normal number, four, of micromeres at one pole and the other cells likewise arranged as if the sixteen celled stage had been cut into two. The same was true of the half-twenty-eight cell stage. Such half embryos can be formed either by destruction of one of the first two cells or by destruction of two of the first four. The same result is produced by destroying any two of the first four cells, whether they are sister cells or first cousins.

[1] This department is edited by E. A. Andrews, Johns Hopkins University.

[2] Entwicklungsmechanische Studien. Festschrift für Nägeli, Zurich, 1891.

The first four cells are thus all alike in their possibilities as well as in appearance; not so the first eight cells, though they all look alike.

When the eight cells are separated into groups of four these give rise to quite different sets, some with eight large, others six large and two little cells, others four large and four small cells. Thus the development of the eight cell stage is largely a process of "self differentiation" of these cells and not due to the mere interaction of the cells of the group.

By destroying one of the first two cleavage cells half-blastulas even, perhaps, half-gastrulas were reared in a few cases from the single remaining cleavage cell. The half-blastulas were obtained both after piercing and removing one cell and by killing it by shaking, which left it still inside the intact membrane.

The half-blastulas showed a tendency to close in as spheres, but died first.

One interesting case suggesting Roux's "postgeneration" was seen, but lost. It consisted of a half blastula lying against a second solid hemisphere covered over by a layer of cells continuous with the half-blastula.

Electricity and Cleavage.—Wilhelm Roux,[3] seeking to determine if electrical phenomena are involved in the process of karyokinetic cell division, subjected frogs' eggs to the action of a current from three Bunsen cells. In these experiments, made in 1885[4], the eggs were placed in a glass tube surrounded by the coiled wire conveying the current.

The result was negative. In the present paper the author describes the results obtained by the use of an alternating current of 100 volts or less, used for lighting the Anatomical Institute at Innsbruck. Here again, the result as far as any connection of cleavage or cell division and the electric current is concerned, was entirely negative. When the current was not strong enough to kill the eggs they divided in the glass tube without any reference to the presence and direction of the current. The same is found to be true of the maximum continuous as well as of the alternating current.

The alternating current is also found to have no directive effect upon the entering sperm or the fusing pronuclei, factors which Roux regards as determining the first cleavage plane. The electric current has, however, a marked effect upon the egg, visible as a change in color at each pole as contrasted with the equator, where such a contraction takes place that at first one might regard the equatorial belt as a cleavage furrow. These changes involve the death of the egg, and are merely a " morphological " polarization produced by the passing current and localized by its direction irrespective of any axial or polar differentiation within the egg itself.

---

[3] Bresl. ärzt. Zeitschrift, 1885, No. 6.

[4] Sitzb. Akad. Wiss. Wien., Jan., 1892.

However interesting and valuable the long series of experiments recorded in the two hundred pages of this memoir may be to the physicist and to the biologist, they have for the embryologist of the present day too little direct bearing to make it worth while reviewing them at length.

It should be mentioned, however, that the most diverse objects, frogs' eggs, gall bladders, embryos, hearts, hydras, tritons, lizard and fish embryos, chick and mammal embryos, as well as inorganic substances, such as mercury, copper, lead, etc., exhibit visible differentiation of polar and equatorial areas dependent upon the direction of passing currents. Yet this is not true of even all organic bodies experimented with.

Membranes of the Sea Urchin Egg.—Curt Herbst[5] repeated the experiment of the Hertwigs, and used in addition to chloroform, clove oil, creosote, xylol, toluol and benzole.

Eggs of the sea urchin shaken in water that had been mixed with small quantities of any one of these substances form an artificial egg-membrane just like that normally formed after the entrance of a sperm in fertilization.

This membrane, the author holds, is made by the hardening of the preexistent hyalin outer layer of the egg.

The subsequent separation of the membrane from the surface of the egg is probably due to the secretion of some jelly-like substance. The egg does not shrink away from the membrane at all.

The sperm has no direct part in the formation of the membrane, but merely acts as a stimulus to the egg. If the membrane is removed from a fertilized egg (by shaking) the presence of more sperms does not cause the formation of a new membrane. If, however, some of the above substances are used, a second membrane is formed. Two membranes, one inside the other, may be formed from eggs having one membrane, or even from those having the first membrane removed. The cause of this membrane formation is to be sought for in the egg itself.

[5] Biol. Centralblatt, Jan., 1893.

Experiments on Cleavage.[6]—Dr. Jacques Loeb, of the University of Chicago, has made a most valuable addition to our knowledge of the cleaving ovum. His experiments were simply the exposure of the eggs of sea urchins (*Arbacia*) to water containing more or less than the normal amount of sodium chloride.

The general result is stated as follows: "If we reduce the irritability of the protoplasm of the egg by reducing the amount of water contained in it, the nucleus can segment without segmentation of the protoplasm. If we increase again later the amount of water, and consequently the irritability of such an egg, the protoplasm at once divides into about as many cleavage cells as there are nuclei pre-formed. The segmentation of the protoplasm in the egg, and probably in every cell, is only the effect of a stimulus exercised as a rule by the nuclei."

The following illustration of the character of the experiment is presented by the author: Eggs taken a few minutes after impregnation were divided into four lots, one put into normal sea water, one into that concentrated by adding 2 g. Na Cl per 100 ccm., the other two into sea water concentrated by addition of 1.3 g. NaC and 1 g. Na Cl per 100 ccm. in each case.

When the eggs in normal sea water had arrived at the two celled stage none of the others had as yet begun to cleave. In the least concentrated solution the cleavage soon followed and in the more concentrated solution it followed about an hour later, but in the most concentrated solution no cleavage took place. Concentrations greater than 2 g. per 100 ccm. produced plasmolysis. The form of the cells indicates the amount of water and the intracellular pressure; thus in normal water the first two cells are nearly hemispheres, but in concentrated solutions the cells approach more and more toward a spherical shape.

Other experiments bring out the interesting point that the effect of salt is not to destroy but to suspend the cleavage phenomena. When the eggs are put back into normal water after staying some time, but not as long as twelve hours, in concentrated water, the suspended cleavage begins and goes on much as in a normally situated egg. The longer the eggs have been in the concentrated water the more numerous are the cleavage cells formed all at once when the egg is returned to normal water. An interval of about twenty minutes in the normal water must elapse before the sudden appearance of the retarded cleavage cells occurs.

[6] Journal of Morphology, vii, 1892.

The behavior of the nuclei of the eggs in concentrated sea water was observed somewhat in live eggs and in certain stained eggs which Dr. Conklin prepared for the author. It seems that the nuclei increase in numbers in the salted sea water when there are no cleavage furrows visible on the outside of the egg, but this increase is not always accompanied by a normal separation.

In the light of the conceptions of Fol and O. and R. Hertwig regarding the effects of polyspermy in producing a cleavage into many simultaneously formed cells it might have been urged that Dr. Loeb's results were due to polyspermy.

Granting, however, that the increase in nuclei takes place while the eggs are in the salted sea water such facts as the effect of this water in paralyzing the spermatozoa, as observed by the author, show that the spermatozoa cannot be connected with these peculiar cleavage phenomena.

Regarding the method of action of the salt used in these experiments we must premise that the author in previous work upon hydroids came to the conclusion that growth and regeneration in animals and plants is a function of the amount of water contained in the cells. The application of this to the present case is in the idea that increasing the concentration of the liquid about a cell decreases its irritability by removing water from it; the effect is the same quantitatively and qualitatively as would be produced by lowering the temperature.

The normal source of the stimulus which the abstraction of water is supposed to render no longer efficient to produce cleavage is considered to be the nucleus. The nature of this stimulus is unknown, but some facts lead toward the assumption that it may be a chemical one.

On the other hand the protoplasm has some influence upon the nucleus; possibly the intracellular pressure determining the form of the cell also fixes the direction of the nucleus, which will then be less defined in a mass without cell walls.

ENTOMOLOGY.[1]

Termitophilous Insects.—E. Wasman has lately described[2] a number of new termitophilous insects, erecting for part of them the genus Termitobia and has summarized our present knowledge of the guests of termites. He says that very little is known concerning the guests of the termites as compared with those of ants, largely because the former are chiefly confined to the tropical and sub-tropical regions and also because the investigation of their nests is more difficult. But in spite of this more than fifty species of termitophilous animals are known. Of these forty belong to the Coleóptera, two to Orthoptera, one to Heteroptera, one to Lepidoptera, two or three to Thysanura, one to the mites (Acaroidea), one to the Arachnida, and one is a Nematode. Of the beetles one is a species of Glyptus with its larva, and thirty-nine are Staphylinidæ. The author refers to the investigations of Mr. E. A. Schwarz in North America.[3]

Notes on the Mouth Parts and Thorax of Insects and Chilopods.—The difference between the mouth parts of true insects and Chilopods are usually mentioned in text-books. But when one believes that insects must have come from some form similar to living Chilopods, it becomes a matter of interest to see what is the homology between the various parts of the mouth. As it is usually stated, Chilopods have one pair of mandibles, two pairs of maxillæ, and a pair of maxillipeds; insects a pair of mandibles, one pair of maxillæ, and a labium. The mandibles are of similar structure in both groups. In Chilopods the first pair of maxillæ are two-lobed; the second pair of maxillæ, or first pair of legs (as it is sometimes called), is, in structure, like a pair of legs; the maxillipeds are a modified pair of legs, large and powerful, used for seizing the prey. The dorsal scuta of the segment to which the maxillipeds belong is frequently not wholly united to the head, but is plainly visible (*Lithobius*).

We here see what is well-known among the higher Crustacea; the tendency to the cephalization of thoracic segments in order that their appendages may function as mouth parts. If such is the case, what has become of the second maxillæ and the maxillipeds? The maxilla of insects is composed of three portions, the palpus, the galea, and the lacinia with the basal joints. If now we look at a Perlid larva (the lowest winged insect) the secret lies revealed; the basal joints of the maxillipeds have united to form the sub-mentum, the remaining joints by their pressure have united to the basal joints of the maxillæ. Yet in the Perlid larva the union is not complete and one can plainly see that the palpiger is not articulated to the stipes, but has basal joints which are concealed by the stipes and the two parts of the cardo. So that the maxillæ of insects is equal to the first maxillæ of Chilopods plus the maxillipeds. The labium of insects appears to be the same as the second maxillæ of Chilopods, the mentum being the united basal joints.

---

[1] Edited by Clarence M. Weed, Hanover, N. H.

[2] Neues Termitophilen, mit einer Uebersicht über den Termitengäste. Verhandl. Zoologisch botanish Gesellsch. in Wien, xli, 647.

[3] Proc. Ent. Soc. Wash., i, 161.

I would also call attention to the steady tendency observable in Chilopods toward the union of certain thoracic segments. In the lower Chilopods (Geophilus) the segments are all of about equal size, and each one bears a spiracle. A little higher, in Scolopocryptops, we see that there are two kinds of segments, the large with spiracles, the small without them. Segments 2, 4 and 6 are small, the 7th and 8th both large, after that every other one is small. In Lithobius the process is continued still further, the small being smaller, the large larger. In Scutigera (the highest Chilopod) the dorsal scutæ of the small segments become united to the larger ones, so that seen from above, the first scuta (prothorax) covers one pair of legs, the second scuta (mesothorax) covers two pairs, the third scuta (metathorax) covers two pairs, and the fourth scuta covering three pairs of legs. Therefore I conceive that the mesothorax and metathorax of insects are each composed of two segments. This would appear quite probable if one but look at a grasshopper; but there exists greater proof. Machilis (a common Thysanuran) has on each abdominal segment a pair of small appendages, which have been recognized as representing legs, but the meso- and metathorax also bear these appendages beside the normal legs; hence if these appendages represent legs the meso- and metathorax of Machilis must be compound segments. It is possible that each abdominal segment is compound, but I hardly think this probable, since the first abdominal segment of insects, which is very small, appears to represent the small sixth segment of Scutigera. If this theory of the insect thorax be true, the thorax consists of five segments, segments one, three, and five bearing legs, segments two and four bearing wings.

Nathan Banks, Sea Cliff, N. J.

The Woolly Alder Aphis.—In the current report of the New Hampshire Experiment Station observations are recorded by Clarence M. Weed which show that in autumn large numbers of the young of this species (*Schizoneura tessellata* Fitch) are born by the parthenogenetic females. These young descend the alder shrubs to the surface of the ground, where they congregate, under various sorts of shelter, in enormous numbers. They remain there throughout the winter, and in spring those which have not been washed away or otherwise destroyed climb up the trunk to the limbs, where they fix themselves on the lower surface of the bark and grow rapidly into other parthenogenetic females. No males, females, or eggs have been found. This insect has been very abundant in New England during recent years; the appearance of an infested branch is shown in the accompanying plate.

Further Note on the Tineid Case-worm from the Grand Canyon—In my description of the seed-like lepidopterous case-worm from the Grand Canyon in the February, 1893, number of THE NATURALIST, pp. 166–169, figs. 2 and 3, it should be mentioned that the hair line in fig. 2 shows *twice* the natural size of the larva. Fig. 2 was intended to be reduced one-half, and was so indicated on the margin of the original drawing. The hair line was made twice the length of the larva, so that when the whole was reduced one-half it would represent the natural size, stated in the description as 2⅗ mm.

It seems very certain that this larva is a tineid. It is well-known that these small larvæ often construct cases in which they live; and, as Dr. Packard states (Guide, p. 342), the larvæ of some of the smaller tineid genera (Antispila, Tinagma, etc.) are absolutely footless.

The narrow-leafed willow referred to in the description is *Salix longifolia* Muhl., while the round-leafed leguminous tree is *Cercis occidentalis* Torr. The elevation of that part of the canyon referred to as 2500 ft. below the rim is 5000 ft. above sea level.

C. H. TYLER TOWNSEND.

The Puparium of Blepharipeza.—*Blepharipeza* is a genus of Tachinidæ s. str., belonging in the subfamily *Hystriciinæ*, and thus closely allied to *Dejeania* and the other Tachinidæ that are characterized by the presence of dense and spiny macrochaetæ on the scutellum and abdomen. *Blepharipeza* may at once be recognized in this group by its hind tibiæ being thickly ciliate on their outer edge with more or less flattened bristles.

The following description is drawn from a puparium of *Blepharipeza adusta* Lev., from which emerged a ♀ specimen of the fly, both of which were sent to me by Mr. Harrison G. Dyar, who bred the fly from a larva of *Halisidota argentata.* It will serve to indicate the distinctive features of the puparium in this interesting genus. I do not know that any description has ever been published of the puparium in this group, except the very brief one of *Belvosia bifasciata* by Dr. Riley (Bull. 3, U. S. Ent. Com., p. 42). The latter indicates the puparium of *Belvosia* to be very different from that of *Blepharipeea* in the structure and situation of the anal stigmata or spiracles. This may serve to emphasize the distinctness of the two genera, which some authors have been prone to combine under the name *Belvosia.*

Description of Puparium.—Length, 10 mm.; greatest width and thickness, 5 mm. Color dark brown. Almost cylindrical, perfectly rounded at both ends, the anterior end a little less in diameter than the posterior, the transverse and dorso-ventral diameters of each segment equal. There appear to be 12 segments, including the capital and anal plates, but the segments are very ill-apparent on the posterior end, very plain anteriorly. A belt or zone of circular (longitudinal to the belt, transverse to the puparium) minute corrugations alternate with one having a rugose surface, there being 10 of the corrugated or fluted belts, and 10 of the rugose or punctured belts. The rugose belts are about one-half the width of the fluted belts, and there is apparently one of each to each segment of the puparium, not including the capital and anal plates. The anterior one-third of each segment is occupied by the rugose belt, and the posterior two-thirds by the fluted belt, these belts more or less clearly defining the segments. Mouth parts of larva showing on capital plate as a wrinkled protuberance consisting of 4 principal eminences, separated from each other by a wrinkle or fold of the integument. Each eminence is more or less minutely wrinkled, the wrinkles as well as the large folds radiating from the center of the protuberance. Anal stigmata showing an anal plate at center of posterior extremity of puparium, as a pair of organs, each marked by 3 short raised ridges, the two upper ones more or less parallel with each other, inclined outward above and at an angle of about 45 degrees with the lower one, which is not quite parallel with the transverse diameter of the puparium. These ridges are usually more or less slightly curved; when curved, it is always with the slight convexity outward from the center of the organ or stigma. The two stigmata occupy the same transverse plane of the puparium. What appears like an anal vent is situated exactly ventrally of the pair of anal stigmata, forming with them the corners of an equilateral triangle, the vent representing the lower or exactly inferiorly directed angle. This vent consists of a circular raised portion of the integument, rugose in appearance, of about the same diameter as either stigma, and with a little circular pit-like depression on top. Exactly ventrad of this vent is a smaller, more irregularly shaped tubercle, apparently situated on the tenth segment. It is hardly more than three times as much removed from the anal vent as that is from either stigma, measuring from center to center.

The puparium is furnished inside with a fine, white, silken, membranous lining.—C. H. TYLER-TOWNSEND, Las Cruçes, New Mexico.

MICROSCOPY.[1]

olution of the Dust Problem in Microscopy.—The of the dust problem is this: Given a stock of cleaned micro- cover-glasses, to keep them clean and ready for use at any without the necessity of brushing or wiping them. The fol- ution is the result of a laboratory study of the problem, and nounced after having received the approval of leading micros-

jects to be accomplished are:—

secure a dust-proof magazine for storing the cleaned micro- cover-glasses in separate compartments for the different sizes s, circles, and oblongs.

provide simple mechanical appliances for removing a single ver without exposing those remaining in the case.

provide an automatic device for warning the operator of the ing exhaustion of his stock of any of the shapes of covers and hus avoiding the necessity of opening the case except to replen-

provide against the breaking or disarrangement of the covers the accidental overturning of the case.

cidentally to provide a mounting table with guides for center- bjects and cover-glasses, the whole apparatus being so con- hat the glasses are not touched by the fingers, and only once rceps until the slide is completed and labeled.

ust-proof Slip and Cover-glass Case[2] fully meets these require-

VI is a front view of the case which is 4½ inches square on and 6 inches high. The slips and mounting table are con- the lower half and the cover-glasses in the upper portion. The table is shown in position for work, and the concentric lines nce in properly centering the objects and covers are seen lluloid slip. Four dust-excluders are hinged to the front oved table, and two of them are shown opened so as to expose through which the cover-glasses pass out upon the grooved he milled head of the roller which pushes the cover-glasses out ts is shown at the side of the case. A screw stop is inserted in of the case above each slot.

C. O. Whitman, University of Chicago.

pplied for.

The case is fitted for 3 inch by 1 inch glass slips of any thickness, and has a capacity of six to twelve dozen. It has four compartments for the cover-glasses of the sizes ½ inch, ⅝ inch, ¾ inch, ⅞ inch, or 12mm, to 24mm., either circles or squares or oblongs of the above widths, and any lengths up to 2¾ inches. The screw stops regulate the depth of the slots for either No. 1, 2 or 3 thickness of cover-glasses.

Plate VII is a vertical section from front to back, showing the plan of the case. The section of the lower half is made in the median plane, that of the upper half in the plane of a screw stop. Through the base (b) projects the stop (s) into a narrow groove in the mounting table (mt) which slides in and out between the base and the floor (f) of the stock compartments (sc′). The service compartment (sc) is deepened by a shallow cavity cut into the upper surface of the mounting table, and in the bottom of this cavity is fitted a sheet of celluloid bearing a series of concentric lines. The slips (ss) are stacked in the service compartment, the lowest slip filling the shallow cavity in the mounting table as shown at (ss′). A warning slip of paper (ws) is folded around the front edge of the top slip. The loose partitions (p) running in grooves in the sides of the case can be removed after sliding back the cover (c). In the base (f′) of the cover-glass case is the groove (r′) for the roller (r) which is made of brass and covered with chamois. To the front of the base is hinged the brass dust-excluder (de) whose lining of silk plush protects the grooved table (t) and the slot (sl) from dust. The dust-excluder also prevents the delivery of a cover glass by the roller except when the slot is opened. Into the slot projects the point of the screw-stop (st) which is so adjusted as to permit the passage into the slot and out upon the grooved table of only one cover-glass at a time. Above the roller are stacked the cover-glasses (cg). Near the top of the stack is placed the warning disk (w) and upon the top cover-glass rests the loosely-fitting follower (cf) which prevents displacement and breaking of the covers, if the case is accidentally overturned. The adjustable partition (ap) may be moved backward or forward to fit any length of cover-glass from ½ inch to 2¾ inches. The cover (c′) is so constructed as to exclude dust.

Plate VIII is a front view of a form of the case as made for one size cover-glass, either circles or squares, and of either ⅝in., ¾in., or ⅞in. diameter. The open dust excluder is hinged above the slot at the sides of the case. The engraving does not show the groove in the table in front of the slot. A slip is shown in position in the mounting table. One of the lateral grooves in the mounting table is not represented.

The plan in general, is the same as in the complete form illustrated in Plates VI and VII.

Method of operation.

Thoroughly dust the inside of the case and partly, or completely, fill the compartments with clean slips and cover-glasses of the proper sizes and place the warnings in position. The apparatus is then ready for immediate use, or at any time during successive weeks or months until the stock of slips and covers is exhausted.

The slips are withdrawn from the case singly by pulling forward the mounting table, and from this they are removed, either before or after an object is mounted, by inserting a finger into the notches cut into the sides of the table. The mounting table is automatically reloaded on being pushed back into the case. The warning slip having been withdrawn, the service compartment is again filled by removing the sliding cover which carries with it the cover-glass case, withdrawing a loose partition and sliding the cleaned slips from a stock compartment into the service compartment.

Whenever a cover-glass is needed, the dust-excluder in front of the proper slot is opened by a touch of the finger, the milled wheel is rotated and the chamois covered roller pushes the bottom cover-glass through the slot and out upon the grooved table, where it is readily grasped by the forceps. This action is positive because the friction between chamois and glass is greater than between two clean glass surfaces. The table being grooved, only the extreme margins of the cover-glass touch it. A touch of the finger closes the dust-excluder.

It will be noted (a) that the slips and covers are doubly protected from atmospheric impurities by the dust-proof case and the constant contact of clean glass surfaces with each other; and (b) that in the process of removal for use they do not come in contact with any surface from which they receive dust. They come out as clean as when, weeks or months before, they were put into the case. Thus the dust problem is solved.—A. H. Cole, A. M., University of Chicago.

Cooling Paraffine.—To those who have experienced the inconvenience and difficulty connected with the preparation of good paraffine sections in the Tropics or even in the Tropical Summers of other climates, the following simple device of Professor C. Gracomini[1] may be a welcome suggestion.

---

[1] Arch. Ital. de Biolegie, IX, 1888, p. 380.

A small rubber tube, a meter or so long is connected with a vessel of ice-water partly stopped at the other end so that a slow stream passes through it. This tube is wrapped around the paraffine block upon the microtome and cools it off so that thin sections can be cut.

If in winter the paraffine is too hard, the same device with warm water may be resorted to.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, February 1.—The following papers were read: Mr. H. L. Harris, A new instance of the capture of streams; Professor W. T. Sedgwick, The natural history of disease.

February 15.—The following papers were read: Professor Henry W. Haynes, More evidence of cannibalism among the Indians of New England; Dr. R. T. Jackson, Notes on the development of palms; Dr. S. J. Mixter, A Massachusetts beaver dam.

March 1.—The following papers were read: Prof. E. S. Morse, A curious Aino toy; Dr. C. Willard Hayes and Mr. M. R. Campbell, The structural features (geomorphology) of the southern Appalachians. Maps and diagrams were shown and a discussion followed, Professor Davis, Mr. Upham and others participating.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Meeting of Biological Section, Feb. 13, 1893. A paper on the Functions of the Internal Ear was presented by Dr. F. S. Lee, based upon a study of dog-fish. The results of experiments were given showing that the semicircular canals are sensory organs for dynamical (rotational) equilibrium, otolithic parts for statical (resting) equilibrium. Each canal appreciates movement in its own plane and by a definite functional combination of canals all possible rotational movements are radiated. This theory explains compensating movements of eyes, fins and trunk. The method of experiment was that of sectioning the branches of the acoustic nerve and stimulation (by rotational movements) of the living swimming fish.

In a paper by Bashford Dean on the Marine Laboratories of Europe a series of views was shown of the stations of Naples, Banyuls, Roscoff, Plymouth, Arcachon, the Helder, and St. Andrews.

H. F. Osborn described the foot of *Artionyx*, the new member of the order *Ancylopoda* Cope. It is distinguished from *Chalicotherium* by the artiodactyle character of ankle and pes.

BASHFORD DEAN, *Rec. Sec.*

The Biological Society of Washington.—The following communications were made: Mr. M. B. Waite, the Destruction of Lichens on Pear Trees; Mr. C. H. Townsend, The Propagation of the Atlantic Coast Oyster on the Pacific Coast; Mr. Charles Hallock, The Geographical Distribution of the Musk-Ox; Dr. C. Hart Merriam, The Four-toed Kangaroo Rats (with exhibition of specimens).

February 25.—Communications: Mr. Sheldon Jackson, The Introduction of Reindeer in Alaska; Mr. M. B. Waite, Variation in the Fruit of the Pear due to Difference of Pollen; Mr. E. M. Hasbrouck, On the Development of the Appendages of the Cedar Waxwing; Mr. F. A. Lucas, The Food of Humming-birds.

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—Special Meeting, February 14.—The program consisted of a lecture, A Primitive Priesthood, by an Initiate. Illustrated by lantern slides by Frank Hamilton Cushing.—WESTON FLINT, *Secretary.*

SCIENTIFIC NEWS.

Errata in Mrs. Bodington's article "Legends of the Sumiro-Accadians of Chaldea" in THE AMERICAN NATURALIST for February, 1893, p. 105.

Page 105, Line 2 from bottom, for Bohu read Bahu. (N. B. Bohu in the last line is correct.)

Page 106, Line 4; for Herodach read Merodach.

Page 107, Lines 13, 18, 21, 25, 30, and 36; for Tzdubar, read Izdubar.

Page 107, Line 14; for Tshtar read Ishtar.

Page 108, Line 1; for Tzdubar read Izdubar.

Page 108, Lines 12 and 31; for Tshtar read Ishtar.

Page 209, Lines 5, 8, 12, 18, 24, 31 and 37; for Tshtar read Ishtar.

Page 110, Lines 4, 7 and 15; for Tshar read Ishtar.

In the January Number, 1893.

Page 14, Note 1; for Story of the Natives read Story of the Nations.

Dr. Henry Wheatland, of Salem, Mass., died February 27, 1893 aged 81 years. Dr. Wheatland graduated at Harvard in 1834, and later at Harvard Medical College. While a student at college he received instruction in zoological studies from Nuttall, the ornithologist and botanist. Later he turned to anatomical work and then to the study of marine zoology. Under his instruction the late William Stimpson did his first dredging in Massachusetts Bay. For many years Dr. Wheatland has been President of the Essex Institute at Salem, Mass., and he has been trustee of both the Peabody Academy of Science at Salem, and the Peabody Museum of Archeology and Ethnology at Cambridge since their foundation. In later years his energies have been devoted to the study of local history. Personally, Dr. Wheatland was a delightful companion, and his stories of the older days of American Science were especially interesting.

Mr. A. Smith Woodward, of the British Museum, has gone to the Lebanon to explore the deposit of fossil fishes.

Professor R. Ellsworth Call is now instructor in Physics and Chemistry in the Manual Training High School, Louisville, Ky.

The Tacoma Academy of Sciences is endeavoring to have the name Mt. Tacoma adopted as the official title of what was formerly known as Mt. Ranier. If the Academy could have the name of the State of Washington changed to Tacoma it would be a great convenience. We have too many Washingtons already.

The Leuckart "Festschrift," the volume of the contributions of the former students of the celebrated Leipzig zoologist, brought together at his seventieth birthday, makes a splendid quarto volume illustrated by forty plates. Thirty-five pupils contributed to the memorial.

Richard Greeff, Professor of Zoology in Marburg, died August 30, in his sixty-fifth year.

J. G. Joessel, Professor of Anatomy in the University of Strasburg, died Dec. 4, 1892, in his 55th year.

Professor W. Pfitzner, of Strassburg, has been appointed to the position left vacant by the death of Professor Joessel. His assistants will be Drs. Mechnert and Heinrich Hoyer (of Würzburg).

Professor F. C. Noll, for many years editor of the "Zoologiscenh Garten," died in Frankfurt a. M. Jan. 14, 1892.

Dr. Jan Pieter van Wickevoort Crommelin, an ornithologist, died in Haarlem, Holland, Oct. 20, 1892.

Thomas John Moore, Curator of the Liverpool Museum, died Oct. 31, 1892.

Dr. Benjamin Vetter, Professor of Zoology in the Royal Polytechnicum of Dresden, and well-known as the translator of many works, died in the night between Jan. 1 and 2, 1893.

Professor H. Schaaffhausen, the anthropologist of Bonn, is dead in his 77th year.

Professor James Ellis Humphrey sailed Feb. 11th on a botanical collecting expedition to Jamaica, where he wishes especially to study the algae of the Caribbean Sea.

Mr. Samuel Henshaw is in charge of the entomological collection of the Museum of Comparative Zoology at Harvard.

The University of Minnesota is publishing a "Quarterly Bulletin." From the last issue (Jan. 30, '93) we gain the following: The herbarium of the University and of the State survey are merged together In the past three years 350 species of Minnesota fungi have been determined. In 1892 over 20,000 species of flowering plants were collected in the limits of the State, and the collections now contain about 900 species from the region. In the line of geology considerable work has been done in collecting lower Silurian fossils near the University; while the collections have received many additions from other States. In zoology considerable work is being done. The Museum has been fitted with cases, but the curator reports that the collections still leave much to be desired. Not half the birds of the State are represented, while the collections of fishes, reptiles, amphibia, etc., are largely in prospect. The labors of the zoological survey during the past summer were mostly in the neighborhood of Mille Lac, which was pretty thoroughly explored, and work is being carried on, so that a few years hence there will be one of the best local faunal collections for reference and comparison in the country. The University also proposes to establish a Biological station on the upper Mississippi to be open without fees to all who may wish to come. The location will be decided later. A laboratory for histology and embryology in the College of Medicine has been fitted up with equipment for elementary and advanced work.

THE

AMERICAN NATURALIST

VOL. XXVII. May, 1893. 317

RECENT STUDIES OF CARNIVOROUS PLANTS.[1]

BY JARED G. SMITH.

N. Tischutkin published an article in 1889 in the *Berichte der Deutschen Botanischen Gesellschaft* on the cause of the digestion of albumen by the leaves of *Pinguicula vulgaris* L. in which he endeavors to show that the process of digestion is the result of the action of Bacteria. This is in opposition to the theory of Darwin and other authors that the digestion is analogous to the digestion by means of pepsin in the animal kingdom.

In an article in volume XII of the *Acta Horti Petropolitani* he further discusses the subject and concludes that the pepsin of the leaves of insectivorous plants is not a secretion of the plants themselves but is a by-product formed by the numerous species of Bacteria found in the digestive fluid.

In his former study Tischutkin performed over one hundred and fifty experiments, using extracts from the leaves of Pinguicula and small amounts of the secretions of the insect catching leaves. Into these extracts and secretions he put small cubes of coagulated egg albumen. In no case did there follow any peptonization of the egg albumen. These results impelled him to take up the further study of the relation of micro-organisms to the digestion of albuminous compounds by insectivorous plants, using other species and genera.

---

[1] Shaw School of Botany, St. Louis. Read before the Botanical Seminar of the University of Nebraska, Feb. 18, 1893.

Certain authors who have investigated the digestive process (among them Darwin, Gorup, Besanz, Reess and Will) have concluded that it is the result of pepsin secreted by the plants. Others, as C. Morren, see only a process of rotting and decay. Tischutkin in his former paper has reviewed the methods by which these various authors have arrived at their results. Morren placed on the leaves of *Drosera binata* Labill. different insects and cubes of coagulated egg albumen and observed that a few hours afterward the albumen became transparent, the angles were rounded off, and after a day or two the pieces entirely disappeared. Microscopic examination of the transparent fragments of albumen revealed the presence of bacteria, monads, and filaments of a mycelium which resembled the conjugating stage of some species of Mucorineæ. He concludes that while this dissolving of the albumen by some absorbent principle is possible, the intervention of pepsin is entirely problematic.

Schimper in the *Botanische Zeitung* for 1882 tells of some experiments which he made with *Sarracenia purpurea.* These are of great value because made on plants growing wild in Massachusetts. A part of the observations were made on insects caught by the plants, and a part by placing pieces of meat on the leaves. He found that on stopping up the mouths of the leaves at their time of opening and thus preventing the free entrance of bacteria the digestion took place no more rapidly than when the bits of meat were placed in pure water, and from this fact he concluded that pepsin was not present. He did not test the liquid by chemical means. He found great numbers of worms in many of the leaves and thinks that they may have something to do in rendering organic matter absorbable.

Hildebrandt in the *Botanische Zeitung* for 1870 tells of the experiments made on the leaves of *Dionæa muscipula* Ell. and on the cups of *Sarracenia, Cephalotus* and *Nepenthes.* He doubts very much whether the insects caught are of value to the plants. "My observations on *Dionæa muscipula* showed me that the long legged spiders which are caught in the leaves exert an injurious influence upon them. A slimy fluid would be secreted, but after a short time the leaves would commence to die, if I had not removed the spider in time."

Aschman in 1875-6 in his work on insectivorous plants throws doubt on the presence of pepsin in the secretions of Nepenthes and Sarracenia, and believes that the digestive process is simply putrefaction.

Thus we see that many authors have expressed the opinion that the digestion of nitrogenous substances by the secretions of the leaves of insectivorous plants is due to disintegration through the action of the lower organisms rather than by active ferments produced by the plant itself.

Following this preliminary statement of the published data of the subject, Tischutkin takes up his own experiments and gives the results which he has obtained.

The objects which he kept in view while making these experiments were, first, to see whether the presence of lower organisms in the secretions was a constant occurrence; second, if uniformly present, could these organisms dissolve albumen; and, third, to compare the results obtained with other insectivorous plants with *Pinguicula vulgaris.* The plants used were *Pinguicula vulgaris, Drosera longifolia, D. rotundifolia, Dionæa muscipula* and *Nepenthes mastersii.* All of these plants, the last excepted, were cultivated under bell-jars to prevent the visits of insects. To procure the secretion he excited the glands by means of cubes of sterilized egg albumen. The leaves of the first three species responded once to the irritation, those of *Dionæa muscipula,* three times. The acid sap thus obtained was examined microscopically every 24 hours for five days. In every case great multitudes of bacteria were discovered, and frequently there were various moulds as well. The author considers this discovery of much importance, because Darwin had stated that the secretions possess antiseptic properties which prevent the rapid appearance of micro-organisms, and compared their action with that of the gastric juice in the higher animals, which, as is well known, destroys injurious and decay-producing lower organisms.

Gelatine cultures were made in the usual manner, using a drop of the secretion from Dionæa and Drosera 24 hours after the commencement of the experiment. After the development of from nine to ten generations on Fleisch-Peptone-Gelatine, the different species of bacteria were transferred to test tubes which contained dilute acid peptone-free meat bouillon. Control experiments were made with test tubes containing sterilized water acidulated with dilute hydrochloric acid. Into each test tube was placed a small cube of sterilized egg albumen. In all of those test tubes in which the bacteria developed there followed a rapid solution of the egg albumen commencing at the surface of the cubes and invariably continuing to their centers until solution or peptonization was complete.

By these experiments the author proved that bacteria which possess the power of dissolving egg albumen are always present in the secretions of insectivorous plants.

The number of species that had this power were:

In *Pinguicula vulgaris*, 4 species.
In *Drosera longifolia*, 2 species.
In *Drosera rotundifolia*, 1 species.
In *Dionæa muscipula*, 2 species.
In *Nepenthes mastersii*, 2 species.

His next experiments were made using the leaves of Nepenthes, where comparatively large quantities of the fluid could be procured without special irritation. He examined fully developed pitchers of *Nepenthes mastersii* and *N. kennedyana*. The reaction of the secretion was neutral. The secretion contained neither peptone nor insects, and yet there were vast numbers of micro-organisms. The liquid from a leaf of each species was poured into two test tubes, one acidulated with dilute hydrochloric acid, the other without addition of acid. A small cube of coagulated egg albumen was placed in each test tube, and they were then placed in a thermostat at a temperature of 37.5° C. At the end of sixteen hours the egg albumen in the tubes to which hydrochloric acid had been added, had commenced to dissolve, but in the other two was unchanged. This experiment was made to satisfy himself concerning the truth of observations made by Gorup, Besanz and Will that the secretion of unirritated pitchers possessed the property of peptonizing egg albumen only after it had passed from neutral to acid reaction. He further says that it is extremely improbable that this peptonizing principle is secreted by the glands of the Nepenthes pitchers, but that it is produced by certain micro-organisms present in the solution. Hence the digestion that takes place is not analogous to digestion of albuminoids in the stomach of man, because in the latter case the secretion of gastric juice follows as a result of direct irritation.

To demonstrate this more fully he repeated his experiments in a modified form, using a neutral secretion which contained no bacteria. For this purpose he selected two unopened cups of *Nepenthes coccinea* and *Nepenthes*——sp. ?——which were so far developed that the liquid was already present in considerable quantity. The leaves were separated from the plant and the petioles were attached to a ring stand so that the pitcher of the leaf was vertical. The outside of each pitcher was disinfected with a freshly prepared 1:1000 sublimate solution in water. After the water of the sublimate solution had partially evaporated, a small hole 3 mm. in diameter was cut in the wall of the pitcher with a pair of sterilized scissors. The secretion from each was then transferred by means of a sterilized pipette into two test tubes each containing two cubic centimeters of distilled water and a small cube of coagulated egg albumen. One of the test tubes was slightly acidulated with hydrochloric acid, the other remained neutral. The four test tubes were then placed in a thermostat at 37.5° C.

At the end of 48 hours there was no solution of the egg albumen, though a control experiment with a test tube containing pepsin gave positive results. Microscopic examination and gelatine cultures gave negative results. These experiments were repeated, using the remainder of the secretion diluted with a little pure glycerin, but the result was the same.

In these experiments the only question that could be raised was whether the pitchers from which the secretion was taken were not too young to contain pepsin. But if one remembers the experiments of Wunschmann in 1872, and also considers that the cups were more than half filled, there can be little doubt on this ground.

To obviate this objection the experiment was repeated in another way. Two cups were taken, the one from *Nepenthes distillatoria* and the other from *N. hirsuta*, which were still closed but appeared to be just ready to open. Considerable secretion was present. The cups were not separated from the parent plants. The wall of the cup was sterilized with a sublimate solution which was washed away with sterilized water. Then a small V shaped opening was cut in the wall above the surface of the liquid. Through this opening in the wall of the cup a piece of sterilized egg albumen one centimeter long and one millimeter thick was introduced into the cup of *N. hirsuta* and a piece ½ cm. long and 1 mm. thick, into that of *N. distillatoria.* The openings in the walls were then covered with pieces of court plaster, and these for protection from the moisture of the culture house were covered with varnish. After four days the cups opened. The pieces of egg albumen were unchanged, not even the corners being rounded off. Pepsin was not present in the secretion and bacteria only in very small numbers.

The secretion from each cup was then poured out into sterilized test tubes containing small pieces of white of egg, and they were set aside at a temperature of 20-22° C. The white of egg in the secretion from *N. distillatoria* was dissolved in four days, that in the secretion of *N. hirsuta* in five. At the same time enormous quantities of bacteria were developed.

After finishing these experiments the author noticed an article in the *Comptes Rendus* for 1890, by Dubois, who had experimented with the secretions of various Nepenthes species taken before the cups had opened. Dubois's results agree with those of Tischutkin. The secretion taken from the cups just as they were ready to open did not contain pepsin and did not affect the cubes of albumen. But after having been exposed to the air for some time, putrefaction commenced and the resultant liquid contained traces of pepsin. Dubois draws the following conclusions from his experiments.

That the secretion of Nepenthes does not contain any
and that Nepenthes is not an insectivorous plant.

That the phenomenon of disintegration, called "diges-
by Hooker, was without doubt due to the presence of
organisms and not to the secretions of the plant itself.

author finds that the results of his various experiments
hat all the disintegration of nitrogenous substances by
ves of insectivorous plants is *directly dependent* upon the
ce of certain lower organisms, principally bacteria, in
retions of the plants.

secretion contains bacteria of many different species,
occi and rod-shapes, and sometimes the mycelia of
s or other fungi. It is evident that most of these orga-
are carried into the cups by the air, though some may
hed in by rain drops or carried on the bodies of insects.

olution of albuminous compounds commences simulta-
y with the development of great numbers of micro-
sms in the secretion.

secretion of the leaves of insectivorous plants is not
ous to the gastric juice of the higher animals. It is
a medium in which bacteria may live and develop
they are breaking up nitrogenous organic insoluble
unds and preparing them for assimilation by the plant.

ill not be uninteresting to present a table showing the
cal composition of the secretion of various Nepenthes
s. The calcium and magnesium are in composition
alic and citric acids.

Malic acid and a trace of citric acid	38.61%
Potassium chloride (Chlorkalium)	50.42
Sodium carbonate	6.36
Calcium	2.59
Magnesium	2.59
Organic matter—a trace	
	100.57.

re are no free acids in the liquid, though Dr. Turner in
eported a trace of oxalic acid.

Without doubt these genera constitute a group entirely unique. They furnish great natural bacteriological laboratories in which the cultivation of microbes which are beneficial to the plant is carried on. It is in a certain sense a symbiosis between the lowest and the most highly organized plants. The higher organisms furnish a food supply for the use of the microbes in order that they may in turn be benefited by food stuffs which the lower organisms manufacture and furnish in convenient form. That the nitrogenous compounds set free by the dissolution of the egg albumen are really absorbed is shown by Darwin in his experiments.

On the ground of his experiments the author offers his conclusions as follows:

1st. The disintegration of albuminous compounds by the secretions of carnivorous plants is due to the growth of micro-organisms, principally bacteria.

2. Micro-organisms possessing the power of dissolving albuminous compounds always vegetate in the secretions of completely developed carnivorous plants.

3. The disintegration of the albumen does not commence at the moment of the secretion of the fluid, but only after micro-organisms have developed in sufficient numbers in the secretion.

4. The micro-organisms found on the leaves of carnivorous plants come principally from the air, though they may be derived from other sources.

5. The name "carnivorous" plants is to be understood in the sense that the plants only assimilate the products which the lower organisms have set free.

6. The rôle of the plant itself is only to furnish a medium in which certain micro-organisms may live and develop.

A NEW THEORY OF THE MECHANICAL EVOLUTION OF THE METAPODIAL KEELS OF DIPLARTHRA.

By J. L. Wortman, M. D.

In the last number of the Journal of Morphology, Mr. Austin Carey gives the results of his studies in the foot structure of the Ungulates. A fair statement of his main conclusions, or rather perhaps the pith and substance of his argument is to be found in the concluding sentence of his article which reads as follows: "That the lines of evolution have progressed with but few useless side variations seems to be the uniform testimony of paleontologists; but that race changes follow those produced in individual life, or that they are directly caused by their mechanical surroundings, I do not think has been satisfactorily shown."

It is not my intention to enter here into a criticism or general discussion of the points this author has raised in his argument, nor will I undertake to discuss at this time the broad question of the transmission of acquired characters. I do, however, wish to say a few words upon the question of the production of crests and keels upon the distal extremities of the metapodial bones. Upon this point Mr. Carey says, (p. 341) "The crests and grooves on the lower metacarpal ends in some forms, produced apparently in relation to the sesamoid bones, is one of the most marked examples of probable mechanical evolution." "But before such structures can be said to prove the inheritance of acquired characters, the question should be tested whether they are not produced somewhere in the history of each individual by the necessary interaction of parts." He further adds in a footnote that "The crests in certain highly specialized forms, like the horse and deer, reach round to the anterior face of the bone and apparently cannot thus be interpreted or assigned to any mechanical origin that is obvious."

With reference to Mr. Carey's first proposition that these metapodial crests are produced during the life of each individual by the necessary interaction of parts, it appears to me to be a very simple one indeed. If they are produced, by pressure during the lifetime of each individual, and are not inherited, then clearly we should find the crests absent in new born animals that had never walked, and in which the metapodials had not been subjected to any impact or pressure whatever. I have taken the trouble to examine a number of such examples in which the distal ends of the bones were entirely cartilaginous, and I find that the keels and grooves are as well developed as they are in the adult animal. I will cite one case in particular in which I happen to know the history completely. During the past winter, a young hippotamus was born in the Zoological Gardens in Central Park, and it was stated to have been a premature birth; the animal lived but twenty-four hours, and I was informed by the keeper that it never stood upon its feet. An examination of the feet shows that the distal ends of the metapodials are entirely cartilaginous, and in them the keels are as well prefigured in cartilage as they are performed in bone in the adult animal. I have also found the same to be true of newborn rabbits and guinea-pigs. In another case of a young buffalo calf preserved in the American Museum Collection, the distal keels of the metapodials are complete notwithstanding the fact that the epiphyses of all the bones are very imperfectly ossified. This evidence, it appears to me, effectually disposes of the question of the production of these structures during the lifetime of the individual. They are as truly inherited as is the number of digits or any other important organ in the animal economy.

Mr. Carey further states in his concluding remarks that "Plasticity of bone, using the word *plasticity* not in a physical sense merely, but to include absorption under pressure, will probably account for much structure in the foot and elsewhere, especially in connection with the joints and in the field of variation and correlation." Now just what Mr. Carey means by "absorption under pressure" is not clear to my mind. If he means a process similar to that of the absorption of the roots of the temporary or milk teeth, then the term "under pressure" is especially inappropriate, since Tomes has shown[1] that this process is entirely independent of pressure of any kind whatever, but is in some way connected with the presence of "myeloid" or "giant" cells. The only other process of "absorption under pressure" with which I am acquainted, is a pathological one. In this case the pressure is sufficiently severe to cut off entirely, or seriously affect the supply of nutrition, thereby causing the death of the part and its subsequent removal by sloughing. This however may be very gradual, so gradual in fact, as to resemble a perfectly normal change, as is often seen in the pressure of an aneurismal sac upon a neigboring bone. It may be true that a process of this nature, having its origin in a strictly pathological cause, may have become normal. Indeed, Huxley has remarked[2] that it is not always easy to draw the line between pathological and normal changes. Upon the whole, however, it seems to me that before we can admit this principle of "absorption under pressure" as having played any important part in the modification of the skeleton, we must require further proof of its existence and its method of operation.

That living bone tissue is plastic, I should say *highly* plastic and that too in the ordinary physical sense, is so abundantly demonstrated upon every hand, that no further argument is necessary to establish the truth of this proposition. It is recognized and acted upon in everyday surgical practice, and the number of cases wherein entirely new joints have been formed in old dislocations, leaves nothing to be desired to complete the proof. The changes thus produced however, have all occurred within the lifetime of the individual and it yet remains to be proven that they are capable of transmission to succeeding generations.

With reference to the production of the metapodial keels or crests, Cope has explained it in the didactyle foot at follows[3]: "A similar cause produces a similar result in the development of the tongue and groove articulation between the metapodials and first phalanges. In alighting on a didactyle foot, the toes are naturally spread, the result being to throw both the first phalanges away from the median line, or axis of impact, in divergent directions. The result of this impact is to produce upon each metapodial condyle as in the case of the humerus, an external roller of smaller diameter than the rest of the condyle, and separated from it by an abrupt crest. In both humerus and metapodial bones these crests are accentuated by a pinching process during flexion and extension. This is produced by the longitudinal torsion which results in all limbs in motion from the arrest of the outward rotation of the foot by the earth on alighting. The pinching of a keel by its groove takes place at all points in the length of the former, reached by the opposite sides of the extremities of the latter during flexion and extension. This keel becomes acute and prominent in the Boöidea and extends to the anterior face of the condyle. This development has been apparently especially due to the presence of two sesamoid bones, embedded in the flexor tendons, one on each side of the middle line of the posterior side of the metapodial condyle. The fissure between these two bones has permitted the moulding of the surface into a keel to fit it. That this has been the case is further indicated by the fact that a median trochlear surface exists at the distal extremity of the first phalanx in all mammals. But a single flexor tendon crosses this articulation, and it contains but one sesamoid bone, to which the trochlear surface is moulded in a concave surface, as is the case of the patella and the rotular groove of the femur."

---

[1] Dental Anatomy, p. 197

[2] Address to the British Medical Association, London Lancet.

[3] The Artiodactyla, American Naturalist, March 1889, p. 115.

In support of Cope's proposition, that the development of crests or keels upon the plantar or palmar aspect of the distal end of the metapodials, is due primarily to the presence of two sesamoids imbedded in the flexor tendons, I can add that in every case where these sesamoids are present, and pressure is exerted by the flexure of the phalanges upon the metapodials, the keels are developed, and conversely, that where the sesamoids are absent or are present without pressure, the keels are absent. The human foot and hand are excellent examples of this. In the foot there are two sesamoids developed in the tendons of the *flexor brevis hallucis* as they pass over the end of the metatarsal of the great toe, to be attached to the phalanx. Now in the act of walking the greater part of the weight of the body falls upon this digit and as the heel is raised and the foot is brought into a more or less vertical position, these tendons are put upon the stretch and pressure results; in this metapodial, therefore, we find the keel present. In the other digits the sesamoids are absent and there is no keel developed. In the upper extremity there are sesamoids developed in the tendons of the *flexor brevis pollicis* at the metacarpo-phalangeal articulation, but owing to lack of pressure the keel is absent. Again in the Spider Monkey there are two sesamoids present in the tendons of the short flexors of the great toe and the keel is developed, while in the other digits there are no sesamoids and no keels. In other species of monkeys on the other hand such as the Macaques, the sesamoids are present and the keels are developed upon all the metapodials. These monkeys are said to be less arboreal in their habits, which would explain the difference in the matter of sesamoids and keels. Among the Marsupials there is no patella in the Vulpine Phalanger, and here we find that the rotular groove of the femur is very little developed. The hallux is without the sesamoids and there is no keel, notwithstanding the fact that there are both sesamoids and keels in the other metapodials. These cases could be multiplied indefinitely showing the same results. I have in fact failed to find a *single example of a metapodial,* in which sesamoids are present and pressure is exerted, *which does not show the presence of the primary keel.*

I will now consider Mr. Carey's other proposition viz: that the crests or keels in certain highly specialized forms reach around to the anterior face of the bone, and are not explainable by, nor cannot be assigned to any mechanical reason that is obvious. I must say that when I met with this problem several years ago, I was somewhat at a loss to understand how any mechanical explanation could possibly be applied to its Professor Cope's explanation of the extension of these keels in the didactyle foot may possibly be the correct one, but I am inclined to doubt it seriously. It certainly cannot apply to the monodactyle foot since it is inconceivable that any "pinching" could occur in flexion and extension of the phalanges upon the metapodials; for the reason that there is no spreading such as he describes in the didactyle foot. It is moreover manifestly impossible that the sesamoids could have come into play to form the keel, because the amount of extension necessary to bring them into the proper position would be so great as to cause complete dislocation of the phalanx. How then can this extension of the keels be explained upon the basis of mechanics?

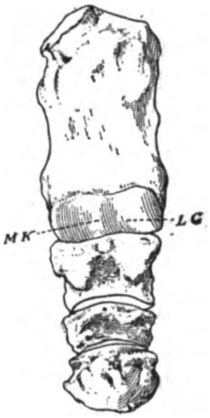


FIGURE 1.—*Coryphodon*, Median digit of the Manus, posterior view. (Coll. Am. Mus. Nat. Hist.)

In the first place it is necessary to call attention to the fact that at least three positions have been assumed in the various stages of the evolution of the ungulate foot, viz: a plantigrade or subplantigrade position, in which not only the phalanges but the metapodials are applied to the ground in walking, as in the hind feet of *Coryphodon* and all the earlier forms; second, a digitigrade position, in which only the phalanges are applied to the ground in walking, as in such forms as the tapir, rhinoceros and the earlier representatives of the horse series; and finally the unguligrade position in which the weight of the body is supported entirely upon the terminal or ungual phalanges. This position of the foot belongs to the higher forms of both the odd and the even-toed ungulates. Now if we attempt to trace the history of the metapodial keels in the evolution of such a form as the horse, no one will deny, it seems to me, that we have here an unusually complete phylum represented, which clearly indicates the different stages in their development. In the earlier members of this series, such for example as *Hyracotherium*, the keels are confined to the plantar and palmar surfaces of the metapodials, and the animal was subdigitigrade. In such a form as *Mesohippus*, on the other hand, we pass from the digitigrade position of the foot to that of the unguligrade, wherein the weight of the body was supported upon the terminal phalanx or coffin bone. Just what induced this change is unknown, but it is more than probable that it was in some way connected with the reduction of the lateral toes.

We do not yet know with certainty the ancestors of the horse series beyond *Hyracotherium*, but there can be little doubt that the feet were pentadactyle and plantigrade. So far at least as the metapodials are concerned, we have such a condition in *Coryphodon*, in which the keels are but faintly indicated, and the two lateral grooves of which the primary keel forms the common median wall, are in the first stages of development. There is every reason to believe that this animal was plantigrade or subplantigrade in gait, and that the failure to develop the keels was due to the more equal distribution of the strain upon all the digits. This is true of the foot of the elephant in which we observe another structure which has certainly had much to do with the retardation of keel development viz: a very thick plantar pad. The possession of this pad not only tends to distribute the strain and equalize the pressure but at the same time limits the amount of flexion and extension of the phalanges. It is a fact worthy of especial note, and one which I will make use of later on, that in all these forms wherein the lateral grooves and keels are very little developed, the plantar border of the arcticular surface of the first phalanx is not at all notched. It is also to be noted that the feet are short and spreading.

With the assumption of the digitigrade position however, the plantar pad was reduced, the foot became more elongated, and the strain became more localized. In this position of the foot the weight of the body falls upon the phalanges, which are now bent at a considerable angle upon the metapodials, and an especial strain is produced by the flexor tendons where they pass over the distal ends of the metapodials. In a foot of this type therefore, do we find a considerable advance in the development of the median keel and lateral grooves of the metapodials? Those of the third digit are most advanced for the reason that the strain is more concentrated and localized at this point. In none of the metapodials however, do the lateral grooves and keel extend more than half-way around the articular ends, nor does the keel rise but little above the lateral boundaries of the grooves. This is well shown in such forms as the tapir, rhinoceros, *Hyracotherium* and nearly all the Eocene Perissodactyla. While the foot remained in the digitigrade position, the median keel of the metapodials made little or no impression upon the lower edge of the articular surface of the proximal phalanx, for the reason that the main flexure of the foot was between the first phalanges and the

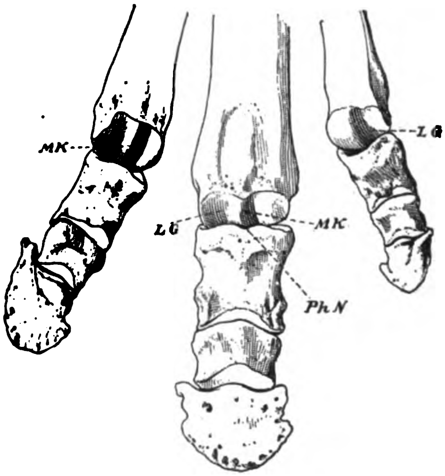


FIGURE 2.—Modern Tapir. Posterior or plantar surface of the hind foot.

metapodials, which would throw the keels so far back as to seldom come in contact with the proximal phalanx. In the middle toe or third digit, of the digitigrade foot however, the main flexure of this toe is momentarily transferred from the articulation between the metapodial and first phalanx to that between the second and third phalanges in the act of walking, and this straightening out of the first two phalanges, so as to bring them in a line with the long axis of the metapodial, has caused the keel to impinge upon the lower edge of the articular surface of the first phalanx which has become distinctly notched.

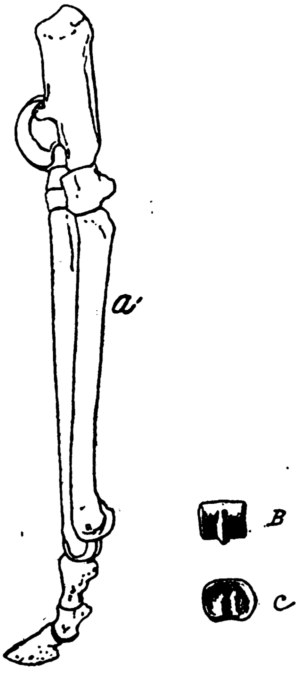


FIGURE 8.—*Mesohippus.* Outer view of the left hind foot. B, Distal surface of median metatarsal, C, Proximal surface of median first phalanx. (Collection Amer. Mus. Nat. Hist.)

It follows that in such forms as the tapir, rhinoceros, *Hyracotherium*, and in fact in all of the truly digitigrade Perissodactyla, the first phalanx of the median digit is always slightly notched, while the first phalanges of the lateral digits are without the notch. This is an important fact, and in connection with what has just been said of *Coryphodon,* I think that it may be accepted as demonstrated, that the formation of this notch is due to the impact of the keel upon the lower border of the phalanx. Up to this stage therefore, we have the following conditions, viz: a comparatively low primary keel bounded upon either side by well marked lateral grooves whose outer borders are as much elevated as the keel. We also note that the grooves and keel extend but half-way around the end of the metapodial, and that the lower edge of the first phalanx in the middle toe is distinctly notched. This may be termed the digitigrade stage in the development of the keel.

In the next or unguligrade stage of this development, beginning with *Mesohippus,*[1] the foot changed from the digitigrade to the unguligrade position in which the main flexure of the foot was transferred to the articulation between the two last phalanges, and the two proximal phalanges came to occupy a position in line with the long axis of the metapodial. It is in this genus therefore, that we find the first distinctive evidence of an advance of the metapodial keel around the lower surface toward the dorsal aspect of the bone. While this advance or extension of the keel is slight, it is interesting to note that the notch in the first phalanx, which we see just beginning in the tapir, has now been transformed into a groove and extended nearly across the articular face of the bone. We are thus able to demonstrate that, in the further extension of the keel of the metapodial beyond that of the digitigrade stage, *the groove was formed in the phalanx first.* It is to be further noted that the keel has become prominent and that the lateral grooves of the metapodials are almost entirely obliterated, at least their outside walls have disappeared, leaving two nearly plain articular surfaces separated by a now prominent, or secondary median keel. Again, if the bones be placed in position, that is, if the first phalanx be articulated with the metapodial, it will been seen that when the phalanx is placed in a line with the metapodial or very nearly so, there is equal bearing upon all parts of the two articular surfaces of the bones ; but if the phalanx is flexed even to a slight extent, then the bearing falls largely upon the keel for the metapodial surface and the shallow groove for the phalangeal surface. When I say flexed I mean bent in the direction of the plantar side of the foot.

---

[1] It is highly probable that the most incipient stages of this process are to be traced to forms somewhat older than this genus.

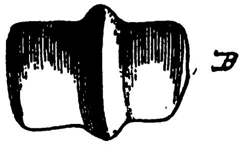


FIGURE 4.—Modern horse. Distal view of median metatarsal or cannon bone, showing complete keel.

How now can we apply these facts to the mechanical explanation of the further extension of the keel toward the dorsal side of the metapodials? When the foot assumed the unguligrade position permanently, we can understand, and have in fact already seen how the keel impinges upon and produces the notch in the phalanx. Any flexure of the phalanx upon the metapodial, under pressure would bring the keel to a more advanced position with reference to the phalangeal articulation, and would cause an extension of the notch in the phalanx so as to form a groove. That the phalanx is so flexed is evident to anyone who has ever studied carefully the movements of the foot of a horse in the act of pulling a heavy load up an inclined surface. Here the phalanx is seen to be greatly flexed when the foot strikes the ground and is therefore under great strain and pressure. I speak of it particularly in a horse pulling a load, because it is more noticeable in this case than in the unencumbered animal, but what is true of one is also true of the other. Now in an animal in which the keels and grooves were little or not at all advanced, such as was the case with the ancestor of the horse when he emerged from the digitigrade and assumed the unguligrade position of the foot, the flexure of the phalanx brought the keel forward and produced a groove in the phalanx. As the phalanx went back to its more normal position, that is, in line with the long axis of the metapodial, there would then be a plane surface of bone lying immediately in front of the keel which would be opposed to a groove in the phalanx. An extension of the keel would necessarily follow as a result of moulding of this metapodial surface to fit the groove. Flexion, therefore, of the phalanx upon the metapodial under pressure, bringing the keel already formed to a more and more anterior position with reference to the articular surface of the phalanx, thus causing it to become grooved, and the subsequent moulding of the keel to fit this groove, I conceive to be the complete mechanical explanation of the production of this structure. The various stages in the forward extension of the keel is to be found in such series as *Hyracotherium*, *Epihippus*, *Mesohippus*, *Anchitherium*, *Hipparion* and *Equus*.

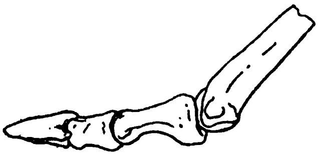


FIGURE 5.—Modern Tapir. Middle toe inside view, showing position of the phalanges upon the ground.

In the preceding discussion, only the possibility of the metapodial keels having been produced and extended forward by mechanical means, has been shown. I will now turn to the matter of the application of this reasoning to the somewhat broader question of the transmission of acquired characters, and see whether or not any argument can be adduced in support of the proposition that the development of these structures has been due *solely* to mechanical causes, and that they have in time been transmitted to succeeding generations. Upon this hypothesis it must be assumed that the changes took place first within the lifetime of the individual and that they finally came to be inherited. It must likewise be shown that wherever a groove or a keel has occurred, there must have been pressure, impact or strain, exerted at that particular point sufficient to accomplish the result. The only other possible explanation of these structures is upon the hypothesis of the accumulation of a number of spontaneous variations in this direction, entirely independently of any mechanical results acquired during the lifetime of the individual. According to this theory, all mechanical influence must of necessity, be rigidly excluded, for the reason that it is possible for it to have been exerted, or come into play only during the time that the foot was in use, and therefore, during the lifetime of the individual. If mechanical influence is admitted even to the slightest extent, then the whole proposition of the transmission of acquired characters is at once proven, and who can say how much is due to mechanics and how much to natural selection?

In the production of the completed keel and phalangeal groove, it must be shown by those who hold the theory of origin purely by natural selection that they are congenitally *correlated structures*, otherwise they must, according to the very nature of the case, have proven injurious to their possessor. In order for a keel to be useful it must be accompanied by a groove into which it is received. In other words it must be shown that any variation in the one *must have affected the other.* I shall now attempt to show that the keels and grooves are not congenitally correlated. It has been shown in the preceding pages, that the phalangeal notch which is the earliest and incipient stage of the phalangeal groove is *not* correlated with the keel. The evidence for this is to be seen in *Coryphodon*, *Elephas*, *Metamynodon*, *Titanotherium* and others in which the keel exists without any vestige of the phalangeal notch. Again, in the tapir and rhinoceros, the lateral metapodials are provided with distinct keels but the notch is absent. In the middle toe of many of the lower Perissodactyla, the keel is associated with the notch, but it was not until the foot assumed a position whereby it was possible for the keel to impinge upon the lower border of the phalanx that the notch appeared. It would indeed require a great stretch of the imagination to believe that the keel and notch were congenitally correlated structures in one toe and not in the others of the same foot! In like manner it can be shown that neither the sesamoids, keels nor grooves of the metapodials are correlated structures, for we have seen that in the human thumb there are sesamoids present but no keels nor lateral grooves.

If upon the other hand we look at the problem from the standpoint here advocated of the mechanical explanation, or kinetogenesis, and we admit that the bone is plastic, then we are forced to conclude, it seems to me, that the lateral grooves and keels of the metapodials are the direct and unavoidable results of pressure exerted by the sesamoids. This is proven by the fact that wherever there are sesamoids present, and strong pressure is exerted, there are developed lateral grooves and median keels, and that where the sesamoids are absent, or no pressure is exerted, there are no lateral grooves nor keels. As long as the foot remained in the digitigrade position the keel did not advance, and this is demonstrated by the fact that there is no animal of this gait that has a completed keel. Up to this point the lateral grooves and keel had a distinct function, viz: to serve as guides for the sesamoids, but when the change was made in the position of the foot to that of the unguligrade, the lateral grooves began to disappear and the keel, which we must regard in the light of a necessary accompaniment of these grooves, began to perform a new function. The excavation of the phalangeal notch, its extension into a groove, and the subsequent moulding of the metapodial surface into a secondary keel to fit the groove were just as much a mechanical necessity as was the original or primary formation of the lateral grooves and keel. The proof of this is to be found in the fact that in the further extension of the keel beyond the digitigrade stage, the phalangeal groove led the way. In the mechanical explanation therefore, we have every condition satisfied, while upon the theory of natural selection of favorable variations the explanation is vague, unsatisfactory and not in accord with the facts.

American Museum of Natural History, March 29th, 1893.

AMONG THE CLIFF-DWELLERS.

By Clement L. Webster.

In the *August* number of the *Naturalist*, for 1891, the writer in an article entitled "*Preliminary Notes on the Archeology of southwestern New Mexico,*" alluded to, for the first time, the most important discovery of a Cliff-dweller Mummy, made by him in a Cliff-dwelling of that region; and promised to, later on, give a more detailed account of the discovery.

The present sketch then may be considered as a partial redemption of the promise then made.

The Mogollon Mountains of southwestern New Mexico, are one of the most rugged and broken of the great Rocky Mountain system.

This region abounds in deep and vast cañons, sometimes so profound as to almost exclude the light of day. This region is also deeply cut and scored by the channels of the headwaters of the Rio Gila, known as the East, West and Middle branches.

At no other place in this great system of mountains, is there presented so abundant and diversified scenes of wild and romantic beauty.

A strange charm surrounds this region; and there is here presented a remarkably rich field for the study and investigations of the Archeologist.

For almost everywhere here in the natural caves, in, and at the base of the almost innumerable cliffs, are found the former abodes of the Cliff-dwellers. Some of these dwellings are solitary, and only large enough to accommodate one or two persons; while others occupy a series of large connected caves, where are sometimes found as many as twenty-five or thirty beautifully preserved rooms or dwellings. The writer spent some time in this region making explorations in these ancient ruins, sketching and drawing; and here obtained a large and exceedingly valuable collection of specimens.[1]

---

[1] See report alluded to in the August number of this journal, for 1891.

Extending out from the West branch of the Gila, about three and one half miles above its confluence with the main Gila, is one of the most beautiful, wild and romantic canyons possible to be found.

The average width of this canyon is perhaps thirty-five or forty feet, while towering cliffs rise perpendicularly on either side to a height of from two hundred to three hundred feet by estimate.

Through this wild glen there rushes, during the rainy season, a small stream of pure water, clear as crystal. The lower nearly one-half of these great cliffs is composed of a hard, dark colored basalt, upon which the elements have made but slight impression; and overlying them is a vast stratum of buff colored conglomerate, such as occupies such extensive areas in southwestern New Mexico, portions of Arizona and California.

Here the lower portion of this vast stratum of conglomerate has been worn away by the slow action of the elements, leaving a narrow projecting shelf of basalt extending along horizontally for some distance.

In the base of this conglomerate, nature has formed numerous large connected caves.

These caves the ancient Cliff-dwellers had taken possession of, and in them reared their strange dwellings.

Here may be seen upward of twenty-eight rooms, of different sizes, shapes and designs; which taken together form the most interesting group of these dwelling which the writer has ever seen.

As the object of this paper is mainly to deal with the discovery of the mummy already alluded to, a detailed description of these and other Cliff-dwellings, etc., will be deferred to a future report.

One of the questions regarding the Cliff-dwellers, is that pertaining to the dispositions made of the remains of their dead.

But very few facts have been obtained thus far, which shed much light upon this question.

There have been discoveries made, however, which demonstrate that in the matter of disposing of the dead, departures from the general custom, whatever that may have been, were occasionally practiced. One of these exceptional cases was brought to light in the discovery of the mummy, which forms the subject of this paper.

This mummy was discovered in one of the rooms of the large collection of Cliff-dwellings just described; and had been carefully placed in an excavation made in the floor, on the side and slightly under the partition wall. The wall here, as well as elsewhere, rested upon the debris which had previously collected in the cave. Every portion of the body, including the nails, hair and teeth, were perfectly preserved.

The preservation of this body was due to the great dryness of the atmosphere of the country, and the chemical elements of the soil, etc., in which it was entombed. The mummy was small, being that of a child apparently about seven years of age; although inferior in size to that of a child of the same age with us.

It had been carefully and completely wrapped in two large pieces of coarsely woven cloth of different textures, made from the fibers of the "Spanish dagger"—which was used so extensively by the Cliff-dwellers for this and other purposes —and then again as carefully wrapped in a large and nicely woven mat of bear grass.

After this, it was bound with cords, onto a small and curiously shaped board of cottonwood; the cords crossing the body and passing through small circular holes made in each corner of the board.

The board had apparently been fashioned with a stone ax, and afterward finished by being rubbed with some instrument.

The hair on the head of the mummy was of a beautiful dark brown color, and of a soft and silky texture. The arms were drawn up near to the sides of the head, and hands clinched; and the legs also were somewhat drawn up.

This description is better illustrated by the plate Figs. 1, and 2, (copied from a photograph) which represent the back and front views of this mummy.

At the feet is shown a portion of the mat which formed the outer covering, and the board to which it was bound.

There existed on the wall of one of the rooms, located a few feet from where the mummy was discovered, many strange and interesting characters, or picture-writings, of these ancient people, painted in the provincial red color.

Close by where the mummy was found, was also discovered an ancient weaving-room, of the greatest interest. In this were found portions of the ancient loom, woven fabrics, etc.

Near the mummy were discovered long braids of human hair identical in all respects with that of the mummy, save that it was much longer and of a coarser texture. In other rooms of this Pueblo, were found great quantities of corn-cobs, husks, and kernels of corn; squash or pumpkin rinds, seeds and stems; gourds, sandals, wearing apparel, basket and other woven work, pottery, stone mills, weapons, utensils, etc., etc. Such a mass of evidence was secured, in connection with the discovery of the mummy, as to leave no doubt as to the genuineness of this relic. So far as the writer is aware, this is the only specimen of its kind of the Cliff-dwellers, ever discovered.

NEW DISCOVERIES OF FOSSIL MAMMALIA OF SOUTHERN PATAGONIA.

BY FLORENTINO AMEGHINO.[1]

I.

At this time, the most important discovery in South American paleontology is the presence of true monkeys in the Eocene of Patagonia. Certain paleontologists have expressed doubts as to the age of the remains. I believe that these doubts have no foundation from whatever point of view one approaches the subject.

From the geological standpoint, the latest researches of my brother, Carlos Ameghino, show that the marine formation, which I have named *Subpatagonian*, and the formation of sub-aerial or terrestrial origin that I have designated *Santacruzian* (the formation which contains the mammals in question), are conformable without a break. The characteristic fossil of Subpatagonian formation is *Ostrea bourgeoisii* (R. de C.). In the east, toward the Atlantic, the lower part of the Santacruzian formation, is found to be intersected with beds of *Ostrea bourgeoisii*, representing the upper part of the Subpatagonian with all the beds of the two formations resting upon each other conformably. In the west, toward the Andes, in the lower reaches of the Rio Sehuen, and in the vicinity of the lakes Viedrua and Saint-Martin, the marine beds of the Subpatagonian formation rest on the Dinosaurian beds of terrestrial origin, contemporary with the North American Laramie (Pehuenche formation); the transition from one formation to the other is almost imperceptible. Throughout this region no mammalian remains have been found in any formation more recent than the Santacruzian. It is then certain that the fossil monkeys belong to this formation. The *Homunculus* specimens have always been found in place, and in the lower Santacruzian beds., It is beyond a doubt that the fossil monkeys belong to the Santacruzian fauna.

---

[1] From the Revue Scientifique, Jan. 7, 1893.

It remains now to ascertain if the Santacruzian fauna is really Eocene, or if it belongs to a more recent epoch. The affinities of the lower part of this formation with the Dinosaur beds, the presence of Creodonts and Plagiaulacidae, the absence of the modern groups of Ungulates, seem to me to demonstrate plainly that we have to do here with a fauna which dates at least from the commencement of the Tertiary epoch, and which represents the development upon the spot of an autochthonic fauna dating from an anterior geological epoch. Another proof of its antiquity is that a large number of Laramie mammals from the United States described by Marsh, have their nearest allies in the Eocene of Patagonia.

On the other hand, some of the forms characteristic of the Puerco fauna of North America are found in beds much more recent (Lower Oligocene and Upper Eocene) of the Argentine Republic in the neighborhood of Paranà (*Periptychus* Cope). It must also be said that all the authors who have studied the conchological fauna of the rocks of Paranà (d'Orbigny, Darwin, Bravard, Doering, Philippi, etc.), have referred this fauna to the Upper Eocene or to the Lower Oligocene. But, between the Santacruzian fauna and the fossil fauna of the Paranà, there is, when we consider the development of forms, a considerable hiatus, almost an abyss, that can only be filled by the aid of a half-dozen intermediate faunas yet to be discovered. Moreover, the greater part of the types of the Santacruzian fauna, considered from the point of view of an evolutionist, represent forms less advanced than do the totality of similar forms found in other continents.

Thus all the evidences—geological, paleontological and evolutional—are in favor of the great age of the Santacruzian fauna. I place this fauna at the beginning of the Tertiary, and consider it to be contemporary with the fauna of the Puerco of North America. I believe that the more we seek to place this fauna at a later date, the harder it will be to explain the affinities it presents with the faunas of other continents.

Returning now to the fossil monkeys of this formation, I can say that my brother, in his last exploration, found some new specimens, among them, a skeleton, almost complete, of *Ho-*

munculus patagonicus, in the lowest bed of the Santacruzian formation. This skeleton is imbedded in a large block of stone, and, as yet, only a few bones have been exposed. The lower jaw has been taken out almost intact, with its entire dentition. This new specimen, the preservation of which leaves nothing to be desired, shows that the jaw is not so narrow nor so compressed as I have figured recently in drawing from a specimen whose symphysis was evidently distorted by pressure. In the new specimen now at hand, the distance between the internal posterior border and the second true molar on each side is 10 mm., 5. It thus results that the two dental series are more widely separated at the back, and that the whole jaw is much more elevated.

The exact dental formula is I $\frac{2}{2}$, C $\frac{1}{1}$, P M. $\frac{3}{3}$, M $\frac{3}{3}$. The first two true inferior molars are very nearly of the same size, but the third is smaller. The internal incisors are weaker than the external ones. The canine is a little more developed than in the first specimen, and is separated from the premolar by a small diastema. It is probable that the two specimens are respectively male and female. Unfortunately, the individual represented by the new specimen, was very old, so that one can no longer detect the details of the surface of the crown of the molars. The dental series measure, in a straight line, 31 millimeters. The femur is 11 centimeters, and the radius 95 millimeters long. The humerus has a large epitrochlear perforation, but it lacks the intercondylar foramen. Each of these bones, in form, are those of a man in miniature.

Among the other forms belonging to the Santacruzian formation, and which ought to be better known, I will select only the most important, beginning with the Ungulates which are exceedingly interesting.

II.

I have been able to reconstruct the foot of the Mesorhinidæ (the genera Mesorhinus, Theosodon, Pseudocoelosoma), which are the predecessors of the Macraucheniidæ. The genus Theosodon had five toes in front as well as behind; the three in the middle were well-developed, very similar to those of *Macrau-*

chenia, but the internal and external on each foot were very small.

The Homalodontheridæ also had five toes on each foot, but with them all the toes are well-developed. The feet are strong and robust, and it is worthy of note that the hoof-bearing phalanges are split up, and have the same shape as those of the Chalicotherium of Europe. The carpal and tarsal bones have the alternate arrangement. The legs are equally robust, and the humerus has an epitrochlear foramen. The bones of the feet and of the legs bear a singular resemblance to those of the Edentates, but there are also more characters of specialization altogether peculiar, without which they might be taken for the direct ancestors of the Edentates. The Homalodontheridæ are the ancestors of the more modern Chalicotheridæ of the Northern Hemisphere. It is a mistake to look for the stock of the Chalicotheridæ in the Meniscotheridæ. The latter represent a type allied to the Proterotheridæ, with which they ought to have a common ancestor as yet unknown.

The Proterotheridæ present us with peculiarities still more surprising. The discovery of the leg bones of the Thoatherium prove that it was a monodactyl like the horse. Moreover, in the *Thoatherium minusculum*, the reduction of the parts was still more advanced than in the horses; the posterior feet are very slender, provided with a single toe, the third, while the second and the fourth are represented only by vestiges of the metatarsals, much more atrophied than are the same bones in the horse. One sees, in this case, an example of parallel evolution very remarkable. A complete reduction of the bones of the foot among the ungulates has taken place in two different families, at two different epochs, a fact perhaps without precedent in the Vertebrate series.

It is, however, certain that there exists a certain ancestral relation between the Proterotheridæ and the Equidæ, for the latter have descended from a form approaching the Protere-therium, but with complete dentition. I have elsewhere stated that in Europe as in North America, one may be able to trace the genealogy of the horse beyond Anchitherium (Mesohippus included), and that one ought to separate definitely from the ancestral line of the horses, the genera Palaeotherium and Hyracotherium, as well as the different types of the sub-order of Condylarthra. In my opinion, the horses originate from a group of Litopterna, from which sprang, at the same time, the Paleotheriidæ and the Hyracotheriidæ, and this ancestral type would be closely related to the Proterotheriidæ.

It would seem that I am right, for the splendid monograph of the genus Mesohippus, recently published by M. Scott, shows that the calcaneum of this genus still possessed a very small articular facet for the fibula, the last vestige of the litoptern organization, however, the shape of the astragalus, as a whole, is already like that of a Perissodactyl.

We now have evidence to warrant the statement that the horses are descended from a form allied to the Proterotheridæ, and which ought to differ from it above all by its orbits open behind, and its complete dentition, in a continuous series. This ancestral is, perhaps, the *Notohippus* or a kindred genus, but, be that as it may, it is undoubtedly in the Northern Hemisphere that the group of horses has acquired the characters which distinguish it at the present time.

The genus *Astrapotherium* is now known, not only by a skull almost entire, but by many of the bones of the skeleton. The skull, in its anterior part, agrees in a number of points with those of the Proboscidians, and could have carried a proboscis as fully developed as that of the elephants. The bones of the limbs also greatly resemble those of the elephants, and there is no doubt that this type represents the nearest relative of the Proboscidians discovered up to this time in the older formations. The genus *Astrapotherium* is certainly not the direct ancestor of the Proboscidians, but only a collateral branch of the trunk from which the latter have sprung. However, some of the other genera of the family of the Astrapotheridæ, Astrapodon for example, may well be considered the ancestor of the living Proboscidians.

In any case, the latter have acquired their characters upon some other continent, as it is certain that during the epoch of the formation of the fossiliferous beds of the Paranà, the Proboscidians had no representatives in our country. These animals did not make their appearance in the Argentine Republic until the end of the Miocene.

The new specimens of fossil rodents taken from the Santacruzian formation afford unexpected opportunities for comparison. The fossil Cercolabinæ of Patagonia are the ancestors of all the hystricomorphous rodents. The Stiromys have, while young, five superior molars on each side, but the next to the last premolar is soon lost. From the primitive Cercolabinæ are derived the Eocardiinæ, the Eryomyinæ, and the Echinomyinæ. The Eocardiinæ, in their turn, have given rise to the Caviidæ and to the Dasyproctinæ. The Octodontidæ, which now seem to be isolated, have come from certain forms of primitive Echinomyinæ. The discovery of complete skulls of the genus Scieromys, enables me to recognize in this genus the true origin of the Octodontidæ. There are still some intermediate forms wanting, but, no doubt, they will be found soon in the fossiliferous formation of the Paranà.

Not only are the Cercolabinæ of the Eocene of Patagonia the primitive source of all the Hystricomorpha, but they are also the ancestors of another group of rodents, the Myomorpha, which seem also, for the present at least, entirely isolated in that order. The origin of the rats is found in the genera Acaremys and Sciamys, from the lower Eocene of Patagonia. The Myomorphs are not derived from the Acaramyinæ, they having lost their premolars and undergone various modifications in the conformation of the skull. If fossil rats have not yet been found in the Paranà beds, it is on account of their fragile bones, but, in all probability, they will be found there some day.

I now know a part of the dentition of the animal that I have named Tidaeus—this name being preoccupied, I substitute for it, Mannodon. The *Mannodon trisulcatus* is the first genus of Plagiaulacidæ of Patagonia which has the inferior molars constructed on the same type as those of the Multituberculata. It is a genus closely related to Neoplagiaulax and Ptilodus.

Many of the types of the Plagiaulacidæ present a feature that is strange to be found among mammals. The Epanorthidæ, for example, have the inferior incisors beveled on their *internal* border, and not on their upper face as is the case among rodents and all other known mammals which have chisel-like incisors the mandibular branches of the same animals have no symphyseal suture, the surface of the bone, at this point, being nearly as smooth as the rest of the jaw. It thus results that the two mandibular rami of the Epanorthidæ were susceptible of lateral movements, and the singular incisors could perform, up to a certain point, the function of horizontal pincers.

Also, although I am quite convinced that the Plagiaulacidæ and the allied fossil forms have been derived from the Didelphian Diprotodontia, the relation with the living Diprotodontia is not so close as I had thought. The discovery I made showing that the large furrowed tooth of the mandible of the Plagiaulacidæ is not the last premolar, as had been believed, but is the first true molar, separates the latter from the living Diprotodontidæ. This character justifies a sub-order in the Diprotodontia, to which can be given the name Plagiaulacoidea, a name which is as appropriate for the northern forms known as Multituberculata as it is for those of the Eocene of Patagonia.

The recent studies that I have made of the Microbiotheriidæ have confirmed me in my opinion that they represent the direct ancestors of the living Didelphyidæ. The latter have certainly originated in South America, and although their remains have not yet been found in the Paranà formations, they will be found there some day.

One of the fossil groups of Patagonia which presents the greatest interest is that of the primitive Carnivora, allied both to the Dasyuridæ and to the Creodonts. It seems to me impossible to find a line of demarcation between them. In studying the material in my possession, I arrive at the following conclusions: The Dasyuridæ are descended from the Microbiotheriidæ and are then modified into Creodonts; these, in their turn, are transformed into the more modern Carnivores. The dental formulæ of these primitive carnivora are varied—take, for example, the superior incisors, of which the Microbiotheridæ have five pairs like the Didelphydæ; the Dasyuridæ have only four pairs, and the same number is found among other forms allied at once to the Dasyuridæ and to the Creodonts. The larger number of the Creodonts have only three pairs, and, in some genera, but two, and even a single pair. There are some specimens in which one can trace the evolution from the primitive formula. Thus, in the genus Amphiproviverra, the internal pair of superior incisors are entirely atrophied and useless, while the other three pairs are well-developed. This proves that it is the internal pair of upper incisors that is lost in the passage from the Dasyurian form to the creodont and carnivorous forms.

Perhaps the most remarkable specimen discovered during the last exploration is a skull almost entire of *Borhyæna tuberata*, an animal which has hitherto been known only by some insignificant fragments. It is certainly one of the most singular carnivores that is known. It must have been rather large since its skull is 205 millimeters long, and nearly 15 centimeters in transverse diameter at the level of the zygomatic arches. The upper arch of the skull is in an almost horizontal plane with the cerebral cavity excessively reduced, but the sagittal crest is very long and well-developed; the frontals have no postorbital apophyses, and the nasals are widened behind in an extraordinary manner; the anterior nasal opening has the characteristic form of placental Carnivora. The lachrymal canals open entirely inside of the orbits. The malar bone is prolonged behind to the glenoid cavity, of whose border it forms a part of the boundary as in the Marsupials. The palate has no palatine foramina. The upper incisors are reduced to two pairs, of which the internal one is atrophied. Between the canine and the external incisor on each side, is a large groove intended to accommodate the lower canine; this groove replaces the deep fossa which is found in the same place in Dasyurus and Amphiproviverra. These grooves and the contraction of the anterior part of the intermaxillary bone, followed by the reduction in the number of the incisors, gives the anterior part of the skull the appearance of a rodent. The canines, premolars, and molars, of each side, form a continuous series. There are seven molars, of which three are premolars and four are back molars. The first have but a single cusp, but they have a posterior heel, well-developed in the last. The first three true molars increase regularly in size from the first to the third, and have the anterior internal cusp atrophied, which gives them a cutting form, especially noticeable in in the third. The fourth is much reduced, and occupies the same position as in the genera Thylacynus, Prothylacynus and Amphiproviverra. Perhaps Dynamictis, of which only the lower jaw is known, is a synonym for Borhyæna. In any case, the latter animal was a formidable Carnivore, as dangerous as our tigers, and which it is hard to classify. It may belong with the placental Carnivores, or among the marsupial flesh-eaters (Dasyures), or with the ambiguous forms known as Creodonts.

It would take too long to speak of the numerous fossil Edentates of the Santacruzian formation and of the many peculiarities they present. However, I cannot resist mentioning one of the greatest novelties of the new family of the Metopotheriidæ, which comprises the genera Metopotherium, Pelecyodon, and Zamicrus. In this group, each of the horizontal branches of the mandibula is formed of two distinct bony parts, one in front, the other behind. These two pieces are united by a suture which commences at the alveolar border, very nearly in the middle of the dental series, and is directed obliquely back and down, terminating in the lower border, almost just below the last tooth. This is evidently a character inherited from the reptiles. The same suture can be seen, but not quite so plainly, in the mandible of some of the Orthotheriidæ.

I remarked, in the beginning of this article, that I had found some forms characteristic of the Puerco of North America in the beds much more recent than those of the Santacruzian epoch. In fact, I have received from the Paranà, a fragment of a upper maxillary, which shows several tooth sockets and one tooth in place. The latter corresponds to a third premolar. It is impossible to separate this specimen generically from Periptychus (Cope). The tooth resembles perfectly the third upper premolar of *Periptychus rhabdodon* and shows the same grooves or wrinkles in the enamel which distinguishes the North American species. However, the South American species (*Periptychus argentinus* Amegh.) is easily distinguished by its size—almost a third smaller—and by the insertion of the molar teeth which are closer together, forming a continuous series. This specimen was found in the Lower Oligocene or the Upper Eocene in the neighborhood of Paranà.

While I am speaking of the fossils of that region, I must add that the doubts which I had concerning the real nature of Ribodon are now set at rest. The new material at hand shows that *Ribodon limbatus* belongs to the Sirenia, and is one of the family of Halitheriidæ.

III.

I would like, in closing, to reply to the objections that have been made to my classification of the Tertiary beds of the Argentine Republic, and particularly to the assertion of Professor Steinmann, who maintains that the beds I have designated Miocene and Pliocene are only Plistocene (or Quaternary).

I have not the complete work of Professor Steinmann, and therefore will refer only to the extracts that he has published.[1]

I am more and more convinced that the Pampean formation is tertiary, and not quaternary. The Araucanian, of which Professor Steinmann speaks, is entirely distinct from the Pampean formation. The vast difference which exists between the Paranà fauna and that of Monte-Hermoso is easily explained by taking into account the fact that the first is Lower Oligocene or Upper Eocene of the old geologists, while Monte-Hermoso is Upper Miocene. Some day, when the Lower Miocene of Catamarca (an Araucanian bed) is explored, and the mammalian fauna of that formation is satisfactorily known, the great break that is now held to exist between the fauna of the Paranà and that of Monte-Hermoso will largely disappear.

I am astonished that any one can still speak of a glacial epoch and of traces of glacial action in connection with the Pampean, and still more so in regard to the pre-Pampean formations. The Araucanian bed is formed by the accumulations of volcanic detritus. The Pehuelche is of fluviatile origin. Is it necessary to repeat for the hundredth time, that there is not the least vestige of glacial action in the Pampean formation?

---

[1] American Naturalist, 1891, p. 855.

It is impossible to name single fossil species from the Pampean formation which is characteristic of a colder climate than now prevails in the same country. On the contrary, not only does the mammalian fauna indicate a warmer climate than at present, but the fresh water conchological fauna also furnishes similar evidence. The many fossil plants of the Pampean formation are the same that are seen to-day in the province of Buenos-Ayres, or in the northern part of the Argentine Republic—not a single form belonging to a cold climate. I am almost certain that an examination of the marine shells of the same formation would lead to the same result. I am about to make a collection of them to send to M. von Jhering, whom I will request to study them from this point of view.

EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—We have had occasion to refer in previous numbers of this journal to the difficulties under which the Geological Survey of Georgia has labored, by reason of the attempts of a political board to assume its direction. This board appears to consist of men ignorant of Geology, and who use the survey as an opportunity for giving places to their friends The director of the Survey, Dr. J. W. Spencer, has not been permitted to direct, nor even to select his subordinates, so that chaos has been the natural result. Ignoring the fact that this state of affairs has been due to their own incompetency, the board has asked for the resignation of the director of the survey. This Dr. Spencer has very properly refused to furnish. In a letter to the Governor he presents a strong defense, which is an arraignment of the board of a convincing character It is evident that the board should resign, rather than the director of the Geological Survey. If they will not resign, the board should be abolished. It appears that their misgovernment has not been confined to the Geological Survey, but that many of the educational interests of the State have suffered at their hands. If Governor Northen desires the acquisition of accurate information as to the material resources of Georgia, he can not do better than retain Dr. Spencer in his present position. If he regards the fair fame of Georgia, he will use what power he has to abolish the present board, and when a competent one is selected, it will permit the State Geologist to select his own assistants. That the Governor sees the question in its true light is evident from the fact that he has requested Dr. Spencer to continue his work and complete the report. It is to be hoped that the Governor's course will put an end to the interruptions and difficulties which have beset the survey for too long a time. Should it do so, he will have the warm commendation of the scientific interests of the entire country. Private interests, especially of mining districts, have often interfered with the comfort of honest geologists, as in the case of Professor Branner, of the Arkansas Survey; but their attacks have always resulted in the scientific vindication of the experts whose education and experience have enabled them to reach just conclusions.

—A RIDICULOUS bill has been introduced into the Legislature of Pennsylvania with the following title and provisions, by Representative

Jno. H. Fow, of Philadelphia, "(No. 163) An Act to prohibit public exhibitions of physical or mental deformities in certain public places."

"SECTION 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, and it is hereby enacted by the authority of the same, that on and after the passage of this act, it shall be unlawful for any person to exhibit in any public hall, museum, theater or any other building, tent, booth, or public place, for a pecuniary consideration or reward, any insane, idiotic or deformed person or any imbecile, and whoever shall exhibit such mental or physical deformity, shall be guilty of a misdemeanor, and, upon conviction thereof, shall be sentenced to pay a fine not exceeding one thousand dollars, or suffer imprisonment not exceeding six months or both, or either at the discretion of the Court."

If this bill becomes a law, it will require the closing of scientific exhibitions of abnormalities to students where a fee is charged, as well as the more popular exhibitions of a miscellaneous character. It will thus deprive the public of a real source of instruction, which is important from various points of view. It will deprive scientific men of the opportunity of examining many curious pathological specimens which the industry of the exhibitors brings together, and which would be otherwise generally inaccessible to them. The Alexis St. Martins, Siamese Twins, double monsters and other such specimens, which are most important for physiologic research, would no longer come to Philadelphia. It will also deprive many unfortunate persons of making a very good livelihood, who would otherwise become chargeable to their relatives or to the State. What good is to be attained by the passage of such a bill it is impossible to imagine.

—THE New York game protector, Mr. Willett Kidd, and the *Forest and Stream* periodical, are to be congratulated on the successful result of their endeavors to enforce the game protection law of the State against the restaurateur Delmonico, of New York City. For having in his possession eighteen woodcock killed out of season, Delmonico has been compelled to pay a fine of $25 apiece—total, $450.00. This result was only attained after persevering efforts, prolonged through many months. The delay was due to the culpable neglect of Prosecuting-Attorney Nicholl, of New York, who would have permitted the culprit to escape, had it not been for the interest of Judge McCarthy, who took up the case himself. We trust that the game and fish laws of all the States may be enforced as effectually, and a great deal more promptly.

RECENT BOOKS AND PAMPHLETS.

Allen, J. A.—On a Collection of Birds from Chapada, Matto Grosso, Brazil, m by Mr. H. H. Smith. Part II, Tyrannidae. Extr. Bull. Am. Mus. Nat. Hist., V iv, 1892. From the author.

Annual Report of the Postmaster-General of the United States for the Fiscal Y ending June 30, 1892.

Aranzadi, D. T. de.—Fauna Americana. Ateneo de Madrid. Leida el dia de Abril, de 1891. From the author.

Beecher, C. E.—Development of the Brachiopoda. Extr. Am. Journ. Sci., V xli, 1891. From the author.

Bibbins, A.—On the Distribution of Cordylophora in the Chesapeake Estuar and the Character of its Habitat. Extr. Trans. Maryland Acad. Sci., Vol. i, 18 From the author.

Boettger, O.—Drei neue colubriforme Schlangen. Separat-Abdrucks aus d Zool. Anz., No. 405, 1892.

——Katalog der Batrachier-Sammlung im Museum der Senckenbergischen Na forschenden Gesellschaft in Frankfurt a. M. From the author.

Boule, M.—Notes sur le Remplissage des Cavernes. Extr. de L'Anthropolo 1892.

——Decouverte d'un squelette d' *Elephas meridionalis* dans les cendres ba tiques du volcan de Senèze (Haute-Loire). Extr. Comptes Rendus, 1892. From author.

Brinton, D. G.—Address delivered on Columbus Day, Oct. 21, 1892, at Library and Museum Building of the University of Pennsylvania, Phila. From author.

Bulletin Agri. Exp. Station of the Rhode Island College of Agriculture Mechanic Arts, No. 19, 1892.

Bulletin Government Agricultural Experiment Station for North Dakota. No 1892.

Bulletin Massachusetts State Agricultural Experiment Station, No. 45, 1892.

Bulletin North Carolina Agri. Exper. Station, No. 87, Sept. 15, 1892.

Bulletin Wyoming Experiment Station. Nos. 1 and 6, 1892.

Butler, A. W.—Some Notes concerning the Evening Grosbeak. Extr. F the author.

Carus, P.—Truth in Fiction. Twelve Tales with a Moral. From the author

Chapman, F. M.—Notes on Birds and Mammals observed near Trinidad, C with Remarks on the Origin of West Indian Bird-life. Extr. Bull. Am. Mus. Hist., Vol. iv, 1892. From the author.

Claypole, E. W.—The Head of Dimchthys. Extr. Am. Geol., Oct., 1892. F the author.

Comparison of the Customs Law of 1883, with the new law of 1890, with Inde which is appended the Administrative Customs Law of 1890.

Dumble, E. T.—Notes on the Geology of the Valley of the Middle Rio Gra Extr. Bull. Geol. Soc. Am., 1892. From the author.

Fabrini, E.—Su Alcuin Felinè del Pliocene Italiano. Estratto Rendiconti della R. Accad. dei Lincei, Vol. i, 2° Sem, Serie 5a, fasc. 7. From the author.

Fairchild, H. L.—Proceedings of the Fourth Annual Meeting, held at Columbus, hio, Dec. 29, 30 and 31, 1891. Extr. Bull. Geol. Soc. Am., Vol. iii, 1892. From Society.

Garman, I.—The Reptiles of the Galapagos Islands.——On Reptiles collected by Baur near Guayaquil, Eucador. ——On Cophias and Bachia——On Texan Reps. Extr. Bull. Essex Inst., Nos. 4, 5, 6. From the author.

Höfer, W.—Vergleichend-anatomische Studien über die Nerven des Armes und Hand bei den Affen und dem Menschen. From the author.

Iolbrook, M. L.—Microscopical Researches of the Corpuscular Elements of od. Extr. Proceeds. Am. Soc. Microsc., 1892. From the author.

olland, T. H.—On the Occurrence of Riebeckite in India.——Chemical and ical Notes on Rocks from the Salt Range, Punjab.——Extr. Records Geol. Surv. a, Vol. xxv, pt. 3, 1892. From the author.

owes, G. B.—On the Pedal Skeleton of the Dorking Fowl, with Remarks on adactylism and Phalangeal Variation in the Amniota. Extr. Journ. Anat. and iol., Vol. xxvi. From the author.

oyt, J. W.—Memorial in regard to a National University. From the author.

utton, F. W.—On the Origin of the Struthious Birds of Australasia. Extr. eeds. Australasian Ass. Adv. Sci., 1892. From the author.

yatt, A.—Address delivered at Mechanics' Fair, Boston, on Public Benefits of Vork of the Agassiz Association. From the author.

ellogg, V. L.—Common Injurious Insects of Kansas. From the author.

upffer, C. V.—Ueber die Entwickelung von Milz und Pankreas. Extr. Müner medicinsche Abhaudlungen. 36 Heft., V. iii, Reihe., 4 Heft., 1892. From uthor.

etter from the Secretary of the Interior transmitting in response to Senate resoluof July 16, 1890, information relative to the Geological Survey.

Iarcou, J.—A Little More Light on the U. S. Geological Survey. From the hor.

Mason, O. T.—The Birth of Invention. Extr. Proceeds. From the author.

Norris, H. W.—Studies on the Development of the Ear of Amblystoma. Extr. ourn. Morph., Vol. vii, 1892. From the author.

Riley, C. V.—Directions for Collecting and Preserving Insects. Part F, Bull. U. S. Natl. Mus., No. 39. From the Smithsonian Institution.

Sainz, L. de H., and T. de Ananzadi.—Un Avance à la Antropologia de España, Madrid, 1892.

Seeley, H. G.—The Mesosauria of South Africa. Extr. Quart. Journ. Geol. Soc., Nov. 1892. From the author.

Slingerland, M. V.—The Pear-Tree Psylla. Bull. 44, Cornell University Agri. Exper. Station, Oct., 1892. From the author.

Smith, E. A.—Sketch of the Geology of Alabama. From the author.

Talbot, E. S.—Statistics of Constitutional and Developmental Irregularities of the Jaws and Teeth of Normal, Idiotic, Deaf and Dumb, Blind and Insane Persons. Extr. Dental Cosmos, July, 1889.——The Jaws and Teeth of a Party of Cave and Cliff-Dwellers. Classification of Typical Irregularities of the Maxillæ and Teeth.

Reprint Dental Cosmos, 1889.——The Differentiation of Anterior Protrusions of the Upper Maxilla and Teeth. Read before Internatl. Med. Congress, Aug. 4, 1890. From the author.

TOWNSEND, C. H. J.—Notes on North American *Tachinidæ* sens. str., with descriptions of New Genera and Species. Extr. Trans. Am. Ent. Soc., Vol. xix, 1892.

——On a Leaf-Miner of *Populus fremonti.*——Notes on Two Mexican Species of Ceroplastes, with a Record of Parasites reared from one.——Extr. Zol., Vol. iii, 1892. ——New Jamaica Tachinidæ.——New North American Tachini. Extrs. Entomo. News, 1892.——North American Genera of Calyptrate Muscidae. Extr. Trans. Am. Ent. Soc., Vol. xix, 1892.——A Sarcophagial Parasite of Cimbex americana. Extr. Can. Ent., 1893.——An Aporia bred from Limacodes Sp. Extr. Psyche, June, 1892. From the author.

VANDERVEER, A.—Hystero-Epilepsy, with report of cases. Extr. Trans. Med. Soc. N. Y., 1892. From the author.

WILLIAMS, G. H.—The Volcanic Rocks of South Mountain in Pennsylvania and Maryland. Extr. Am. Journ. Sci., Vol. xliv., Dec., 1892. From the author.

WOOD, H. C.—The Relation of Neuropathic Insanity to Crime. Reprint Internatl. Med. Mag., July, 1892. From the author.

WRIGHT, G. F.—Unity of the Glacial Epoch. Extr. Am. Journ. Sci., Vol. xliv, Nov. 1892. From the author.

RECENT LITERATURE.

A Summary Description of the Geology of Pennsylvania. Vols. I and II.[1]—The results of the Geological Survey of Pennsylvania from its beginning, in June, 1874, to the close of its field work, June 1, 1890, have been summarized by Professor J. P. Lesley, in three octavo volumes of 700 to 800 pages each, of which Vols. I and II have just been issued, while Vol. III is promised in June, 1893. This summary is compiled from the reports published by the Board since 1875, with the corrections, and the additions that the accumulation of fresh facts make necessary. Vol. I describes the most ancient deposits: The Laurentian granites, gneisses and mica schists; the Cambrian gneisses, schists and limestones; the lower Silurian limestones and iron ores, roofing slates and mountain sandrocks; Formations II, III and IV, in the order of advancing time and superposition. The second volume describes the Upper Silurian red shales, limestones, and fossil iron-ore beds; the glass sand-quarry rocks; the black and gray shales, and the gray and red sandstones, with fish beds; Formations V, VI, VII, VIII and IX reaching to the top of the Catskill Mountain rocks, the upper limit of the Devonian system.

Each formation is discussed in detail. Its geographical distribution, thickness, lithological characters and fossil contents are carefully described, together with its relation to similar formations of neighboring states.

The question of sedimentary Archean rocks receives attention, and while discussing Archean rocks in general, Professor Lesley calls attention to the fact that the Huronian rocks of Canada are nowhere recognized along the Highland Belt from the Hudson to the Schuylkill. In the author's opinion, the term Huronian, "must be used simply as a proper and private name for a series of rocks exposed along that part of the northern boundary of the United States." In the paleozoic series, Professor Lesley does not clearly discriminate between the Cambrian and Ordovician limestones, including them all under the one head of No. II, as was done by the first geological survey. He leans toward the explanation given by Dr. Fraser of the structure of the Chester Valley, rather than those of Hall and Rogers.

The illustrations are numerous, many of them being photo-electrotype reductions of the drawings made by the assistant geologists. Page plates of fossils accompany the chapters of the several formations. These are half-sized reproductions of the figures of fossils given in Report P. 4, Dictionary of the Fossils of Pennsylvania and the surrounding States, published in 1889–1890.

---

[1] A Summary Description of the Geology of Pennsylvania. Final Report ordered by Legislature, 1891. Vols. I and II. By J. P. Lesley, Director, Harrisburg, 1892.

The present report has been evidently written with an eye to the general rather than the scientific public. As a popular synopsis of the geology of Pennsylvania, it will have much utility. As a discussion of the more abstruse problems presented by the structure of the formations of the State, especially of the eastern region, it has less value.

The Earth's History,[2] by R. D. Roberts, is an attempt "to furnish a sketch of the methods and chief results of geological enquiry, such as a reader interested in the subject for its own sake would desire to obtain. It is not intended to be a text-book of Geology." Beginning with a brief history of geological thought, it takes up the earth-history and shows how geologists are enabled to trace the successive steps in the development of the earth's physiography, by reference to the records of the rocks as interpreted by means of the results of investigations into the processes at present active on and beneath its surface. The central idea of the author is "to reconstruct, from ancient fragmentary remains, the old conditions that characterized the successive stages in the evolution of the land areas; to make out the life-history of the earth," and this idea has determined the method of treatment of the subject matter. The book is not crowded with geological facts, it is not a dry abridgment of some popular manual of geology, but it is exactly what its author intended it should be—an exposition of geological logic. Its style is simple and clear, its statements are accurate, and its various parts are well proportioned. In short, it is an excellent volume for collateral reading for college classes in geology, and a fine introduction to the geological methods for general students.—W. T. B.

Wright's Light,[3] although mainly a discussion of light phenomena that may be projected upon the screen by means of a lantern with the lime light, is nevertheless, an excellent volume for study by the students in the theory of light—natural and polarized. The value of the work to the student of polarized light lies in the fact that many experiments are described that aid one to gain a clear notion of double-refraction, of interference, and of the resolution of vibrations into two sets at right angles to each other, without compelling him to accept the conclusions of mathematical processes. Scattered between chapters dealing with the experimental data are others, in which these data are explained, and a few in which the theory of light vibrations is discussed, the whole forming a logical exposition of the modern theory of light.

---

[2] The Earth's History, an Introduction to Modern Geology, by R. D. Roberts, University Extension Manual. New York: Scribner's Sons, 1893, pp. 270, Pl. ix. Price, $1.50.

[3] Light, a course of Experimental Optics, chiefly with the Lantern. By Lewis Wright; 2d Ed. Macmillan & Co., pp. 391, Pl. 9, Figs. 207. Price, $3.25.

Unfortunately for the reader, there are many clumsily-constructed sentences in nearly every chapter of the book, which need much close study before the meaning of their author can be discerned. This fact necessarily detracts from the delight with which the volume would otherwise be perused, but not so much so as would be the case were it not so compactly written. An immense amount of material is collected within its covers, and very little of this matter could well be spared by the student. A little more confidence might have been felt in the author's statements, as representative of the most modern views of light specialists, had he given some evidence of his acquaintance with the wonderful grating of Rutherford and Rowland, instead of mentioning only Noblet's gratings and Barton's buttons in his discussion in diffraction. The imperfections, however, are slight as compared with the abundant good qualities of the book.

The volume is well printed and splendidly illustrated with a wealth of cuts and nine lithographic plates, of which four are beautifully colored.

The student of light phenomena will find many of his difficulties in understanding the theory of his subject cleared away if he will carefully examine the experiments described by Mr. Wright, and thoroughly digest the accompanying explanations.—W. T. B.

General Notes.

GEOGRAPHY AND TRAVELS.

Africa.—IBEA, OR BRITISH EAST AFRICA.—Although the continent of Africa is now gay with the colors which distinguish the spheres of influence of the various European countries, and though it has now been crossed and re-crossed in almost every conceivable direction, there are still considerable areas about which very little is known. This is especially true of the regions adjoining and intervening between the great lakes of the Equator; those vast fresh-water areas dimly known to the ancients, but entirely lost to the moderns until the present generation. The politico-religious troubles in Uganda, which some endeavored to convert into reasons for the abandonment of that country by the British, have directed considerable attention toward that region, and Captain Lugard, whose name has been prominent in the recent troubles, has not been slow to furnish information. The British sphere of influence in this quarter is separated on the north from the Italian by the river Juba, while to the southwest a line drawn from the center of the east shore of Victoria Nyanza, to a point on the ocean near the island of Penba marks the edge of the German sphere. This line is however, bent northward around Kilima njaro, so that the whole of that snow-clad elevation is within the German sphere. At the Victoria Nyanza the Anglo-German boundary is deflected westward. Upon the west, the British protectorate is bounded by the Congo State. The territory of Uganda stretches along the north and northwest shores of the great lake, extending inland as far as Unyoro, which skirts to the southeast shores of the Albert Nyanza; eastward of Uganda toward the Albert-Edward Nyanza, lies the district of Ankoli. The whole of the British sphere in northeast Africa has received the name of "Ibea," formed from the initials of Imp. British East Africa Co., and, as this name is both short and pretty, it may be hoped that it will persist when the company itself is a thing of the past.

Captain Lugard's route to Uganda was from Mombasa to the little river Sabaki, to the south of Mount Kenia, which is entirely within the British sphere. According to him, the source from which the great Victoria Nyanza derives its supply of water is among the chief geographical puzzles of Africa. All the rivers flowing into the lake are very small, and the broad Somerset Nile which flows out of its northern coast certainly carries away more than is received by their combined streams.

The greater part of the waters which fall upon the Uganda region seem to make their way either to Lake Rudolf or Lake Baringo, and we must therefore assume that Victoria Nyanza is fed by springs. The western shore of Lake Albert is faced by a lofty plateau, the waters of which flow, not to the Nile basin, but to the Ituri, a tributary of the Congo. The Senliki River, which, under various names, unites the Albert-Edward or Mwutanzige Lake with the Albert Nyanza, is relatively small where it issues from the former, and its considerable volume at its entrance into the latter is due to the affluents which flow from the western extremity of the snow-capped range of Ruwenzori. Though the eastern portion of this range drains directly into the Mwutanzige, the waters flowing from the western part are sufficient to convert the lower portion of the Senliki into a deep and rapid river. Adjoining the Victoria Nyanza on the northeast is the fertile district of Kavironda, where much grain is grown and where the natives, a good-natured and merry set, wear no clothing of any kind unless the tusks of wart-hog, horns and wings with which the warriors decorate their heads can be considered as clothing. Passing west from Kavirondo to Usoga, a district tributary to the Waganda, the character of the agriculture suddenly changes, the grain giving place to bananas, potatoes and cassava, though no marked difference of soil or aspect can be detected in the surface of the country. Moreover, the transit is from nudity to clothing, for every native of Usoga, like the Waganda, is dressed in the mbugu, an ample garment manufactured from fig-bark. The dress of both sexes is the same, but while the mbugu of Usoga is black, that of Uganda is brick-red. East of Kavirondo is an equatorial plateau seven to eight thousand feet above the sea, apparently well-suited for the residence of Europeans, and gradually sloping to the Kavirondo lowlands. In various parts of this plateau are still to be found remnants of the once powerful nation of the Gallas whose forces have been exhausted in the struggle with the Masai to the south and the Somals to the north. A curious feature of the districts of Uganda and Unyoro, according to Captain Lugard, is the scarcity of running water, and the occurrence of swamps in every depression. The average elevation of Uganda is 3,700 feet, while Unyoro, though not greatly dissimilar in general aspect is higher, and has loftier hills. The Waganda possess great natural aptitude, are clever carpenters and smiths, and can be readily taught European methods of working. They are fond of music, have many rude musical instruments, and possess a currency of cowries. Mentally, they are certainly superior to the surrounding races. Uganda is divided into ten provinces, each of which has its chief, while over all is set a vizir. The system of land-tenure is very complex, and chieftainships are complicated. The northern part of Ankoli is thickly peopled, but the land has suffered terribly from the cattle-plague, which has reduced all the pastoral tribes of this region to a state bordering on starvation. Not only have millions of domestic cattle fallen before this dread disease, but the buffalo has been practically exterminated, while the eland and the smaller kinds of antelopes have suffered severely.

The Albert-Edward or Mwutanzige is really a double lake, for the long northeastern arm known as Ruvango is only connected with the larger body by a river not more than 500 yards across. This lake is abundantly supplied; the Mpanga alone brings down more water from Ruwenzori than is taken out by the Senliki.

During his circuit from the Victoria by the Albert-Edward to the Albert Nyanza and Wadelai, Captain Lugard picked up the Sudanese refugees left by Emin Pasha, and upon his return was accompanied by some 9000 people. He concluded his address before the Royal Geographical Society with a graphic picture of the present disordered state of the countries west and north of the Uganda, smitten by the cattle-plague, oppressed by a usurper named Kabarega, and only prevented from freely accepting protection, from the fear that all protectors, like Stanley, will depart and thus leave them a helpless prey to the vengeance of their oppressors.

Uganda is a region of rounded grass-clad knolls, while Unyoro is more rugged, often with fantastic piles of granite, and abounds in caves. The rivers of Uganda are large papyrus swamps with no current, and little open water. The hills are of red marl or shaly gravel. In past times Uganda had broad roads, often with culverts across water, and even now it would be easy to make a good road to the Albert Nyanza. More grain is grown in Unyoro than in Unganda. A survey for a projected railway from the coast to Victoria Nyanza has already been made for 350 miles.

There seem to be several small lakes in Buddu, a province of Uganda west of the Victoria Nyanza; in Koki, a tributary state east of Buddu, and in Ankoli, the eastern part of which has loftier hills and poorer soil than Buddu. One of these lakes, between Ankoli and Koki, is named Kashera. Iron seems to be abundant in these districts. The natives of Ankoli are Wahuma, a fine race apparently with affinities to the Galla and Somali, but mingled with Bantu.

The Tana, a large river south of the Juba, has been navigated by Captain E. G. Dundas in the stern-wheel steamer *Kenia*, to within a short distance of the mountain of that name, which was afterward ascended to a height of 8,700 feet. The Tana has two mouths, the northern one, the Ozi, is not now important, but the entire district between it and the Tana mouth is alluvial. The lower portion of the river is almost meridianal, but close to the equator a broad westerly curve conducts to the congeries of affluents which descend from the forest-covered slopes west of Mt. Kenia. The steamer could proceed as far as Hameyé, near the equator, at the start of the great bend. The peoples met with in the ascent were the Kalindi at the mouth, the Ngao, Omoina, Ndera, Guano, Ndura, Sabaki, Malululu, Malakote, Wasania, Korokoro, Wandorotu, Murdoi, Wathaka, Mumomi, Mbe, Kikoya and Muea near Mt. Kenia.

The smaller Sabaki river to the south of the Tana, also has its head-waters in the forest belt S. W. of Kenia. The existence of such a river as the Tana, navigable through more than three degrees of latitude, was until recently pratically unknown. A considerable fall about 18° south of the equator, and sixty feet high, terminates the navigable part of the stream.

It may be remembered that Mt. Kenia has been ascended by Count Teleki to a height of 15,350 feet, yet he estimated that there was still above him 3,500 feet to the highest summit. The forest reaches to 3,500 feet, bamboos to 10,500, after which the vegetation as far as the snow-line at 15,000 feet consists of mosses and the curious tree *Senecio johnstonii*. The slope toward the west is very gentle, but southward the mountain presents a serrated ridge four miles in length.

An expedition has started for the Juba River commanded by Lieutenant C. R. Villiers, and accompanied by J. W. Gregory of the British Museum.

Asia.—A VISIT TO PEIK-TU-SHAN.—Mr. Carles has recently paid a visit to the singular white-topped and flat-topped mountain in Mantchuria, from which issue the sources of the three great rivers Tumen, Yalu and Sungari. This mountain, which has upon its summit a lake some twelve miles in circuit, at an elevation of 7,500 feet, had been previously been visited by Mr. Younghusband and his party, but Mr. Carles was moved to undertake the journey from Seul, the capital of Korea, by reading an account of it in a Chinese work.

This account, exaggerated though it was, giving to the mountain a height of five miles, and to the lake a proportionately expanded circumference, showed that there really existed a remarkable elevation. Chan-y-Peik, the "Ever White Mountain," is well-wooded to the top, and thus presents a contrast to the isolated Peik-tu-Shan or Old White Mountain the summit of which is bare, and white with pumice. It is the latter which encloses the lake.

The account of the journey, in the March issue of the Proceedings Royal Geological Society is full of interesting matter concerning the ways of the large-hatted Koreans, their threshing-floors of beaten clay, the pickled cabbages and turnips so dear to their palates, their dress and domestic animals, among which the black and hairy pig is conspicuous. The untidiness of a Korean village offers a marked contrast to the neatness of a Japanese one, but Mr. Carles gives the Korean rustics credit for a more thorough appreciation of natural beauty than is possessed by any other people. A Korean who has climbed a summit stops, not to complain of the toil, but to admire the landscape. Ham-Heung, the chief town of N. E. Korea, is a walled town with twenty-five to thirty thousand inhabitants.

THE KACHINS AND THE IRAWADI.—The recent expedition of the Indian Government among the hills of the rebellious Kachins, Chingpaws, or Singphos, who occupy much of northern Burma, toward the Chinese frontier, though they have added to our geographical knowledge of the upper waters of the Irawadi, have not solved the mystery of the Salwin. The upper Irawadi divides into two principal streams, the Mali Kha to the west, and the more easterly Nmai Kha. The course of the former has been mapped as a result of the Kachin expeditions, but little is really known of the latter, save that at its junction with the Mali Kha it is somewhat the larger.

The Kachins seem to be descended from the Karengs, and have for ages been subject to hereditary chiefs or Sawbwas; but of late years many villages have rebelled against these, driven them out or killed them, and these villages are now only governed by 'headmen' with little authority. This, together with the fact that the peaceful trading villages of the Shans and Chinese are each under the protection of a Kachin village, made it difficult to reduce the tribes to subjection. Among the Kachin tribes are the Kanong, Passu, Nankmong, Kamans and Khangs, these are said to be the wildest, and to be unclothed. The district is not one of lofty mountains, but of rugged hills two to three thousand feet in height, intersected by well-watered valleys. A good deal of opium is grown, but not enough to fully supply this opium-consuming race. No reliable information can be obtained respecting the head-waters of the Nmai Kha. It is thought that the Phung Mai, east of Kanti and the Nmai Kha, may be the latter, while the Lu is the Salwin. All the water that falls upon the land up to within a few miles of the Lu drains to the Irawadi, which thus rapidly develops into a noble river, though it is doubtful whether any of its sources are farther north than 28° 30′.

East Asia Minor.—In these days of exploration of the unknown, some of the districts that have been longest known, and which fill large pages of the world's history, seem to be least visited. It is this which lends additional interest to D. G. Hogarth's account of his travels in Asia Minor—that land of many peoples and of many ruins which has for centuries been the stronghold of the Turkish power. Mr. Hogarth not only examined many ruined cities, but penetrated through several little known passes of the Taurus and Anti-Taurus. In the district between Lakes Egerdir and Beysheher there are no passes, but the Eurymedon cuts its way through a great gorge, and the population interests from its primitive and apparently indigenous character. The Pisidian city of Adada, now Kara Bavlo, perched high on its hill-top, is a most perfect specimen of an Anatolian city of Roman times. Not very distant are the ruins of Lystra and Derbe.

In a small island upon Lake Egerdir are the remnants of a small colony of Greeks, who in the twelfth century deliberately preferred Mohammedan to Byzantine rulers. The monastery of Koja Kalessi is a remarkable ruin, containing a church of the fourth or fifth century, restored in the reign of Justinian, and evidencing the power still possessed by heathen traditions in the entire absence of Christian symbolism from its sculpture. The city of Coropissus is a veritable Pompeii, the church probably of the seventh or eighth century, most of the ruins a little later. The east Taurus is richly wooded, and is traversed by the tremendous canyons of Samanti, Saros and Jihan, not passable even on foot. Several important passes occur farther east than the famous Cilician Gates. This district was the last refuge of the independent Armenians of Cilicia, and their robber towns, Hadjin and Zeitun, still exist. The half-troglodyte Kurds, nominally Mussulmans, but with pre-Mussulman customs, have penetrated to these parts. The Anti-Taurus, deserted since the eleventh century, is now inhabited only by the nomad Avshar and some Kurds, who found their way there about fifty years ago. The great Roman road to the Euphrates can still be easily traced in the valley of the Saros, and has many milestones. The fortified tower of Maidan dates from the first or second century, when the Cilicians were lords of the Mediterranean. Among so-called Hittite monuments, one of the most important is the obelisk at Albistan. This the inhabitants refused to sell to some Germans, the Government heard of it, and took possession without payment. It has sixty-seven lines of inscription on all four sides.

NORTHEAST SIBERIA.—The region of the Verkhoyansk and Stanovoi Mounts, in N. E. Asia, with the upper basins of the Kolyma, Indigirka and Lena, have been recently explored by M. Cherski. Proceeding up the Chandyga River, Cherski reached the heart of the Verkhoyansk, whose summits are below the snow-line. Then by way of the river Dyba, a tributary of the Tyra, he reached the valley of the Omekon, which stream the natives regard as the true head-waters of the Indigirka. The Uchagei-urach does not, as shown on the maps, empty into the Omekon. The Verkhoyansk was then crossed at its junction with the Stanovoi range, where the latter runs eastward. The region between the Indigirka and the Kolyma, covered by the bend of Stanovoi, is split into several subdivides, of which the expedition crossed three, and found the third to be the water parting between the Indigirka and Kolyma basins, the Moma flowing from one side, the Syrjanka, an affluent of the Kolyma, from the other. The valleys of this district are broad with gentle slopes, and without terraces, which are destroyed by the shifting courses of the rivers, the tendency of the latter being rather to fill up the valleys with rubbish than to deepen them. On the southern slopes magnificent poplars and willows flourish, and the meadows have a rich flora. Notwithstanding the high latitude, the temperature in June and July rose to 113 in the sun, though for fourteen days in August it sank below 32. The great longitudinal valleys seem to have possessed immense glaciers in the plistocene period; while the mountains are formed of Silurian and Jurassic folds.

ASIATIC NOTES.—The recent expedition of Lieutenant H. S. Walker, from Napeh in Upper Burma to Arakan, possesses considerable interest, were it only for the visit paid to Myohaung, the ancient capital of Arakan, now peopled only by some 2500 souls. The ancient magnificence of the place is attested by the great ruined walls, forming three squares one within the other, and by two gigantic pagodas, one with eighty, and the other with ninety thousand images. This city was known to Ptolemy, who speaks of it as Triglyphon.

The outward route was through the An Pass, while the return route was eighty miles to the north. The former was found far the better for a railway, though beyond Dalet it was cut up by creeks, many of which, however, could be missed by hugging Myaintaung Hill. Lieutenant Walker speaks of the Arakanese as indolent and cowardly beyond measure.

W. M. Conway, with a party, started in February of the past year to explore the glacier regions of Baltistan and Karakoram, southeast of Pamir. News of his expedition has several times been received, but no full account has yet been given. He has been the first European to cross the Nashik pass; has explored the Hispar Glacier, a vast level sea of snow of 300 square miles, surrounded by a ring of giant peaks—the largest glacier outside of the polar circle; has ascended many lofty peaks, among which is one which he has named Pioneer Peak (over 23,000 feet) because it was found to precede the Golden Throne, some 2000 feet higher still.

A new map of Persia, compiled from a great number of general and divisional maps, may be found in the issue of the Proceedings Royal Geographical Society for February, 1892. It is on a scale of 600 miles to the inch, and includes Afghanistan and Beluchistan. The boundaries of the famous Persian desert, the Dasht-i-Kavir, with its two large salt-swamps, and the Kuh-i-Gugird, are clearly shown. The desert is shaped like a dumb-bell, and the largest salt-swamp is in the centre of the western portion.

Captain Bower and Dr. Thorold left Leh in June last year, crossed the widest part of Tibet, and passed a chain of salt-lakes, one of which, Bor-Ba-Tu, is probably the highest lake in the world, since it is situated 17,930 feet above sea-level. Their course lay from Ladak to Chiamdo, about 150 miles to the north of the route of Pundit Nain Singh. Though ordered back by the Tibetan authorities, they made their way through Tibet to west China.

Burma and Assam seem temptingly close upon the map, and are only separated by about a hundred miles of hill country, yet a satisfactory road from one to the other has not yet been found. The highest hills or mountains of the district range from but four to eight thousand feet, but as they are clothed with dense forest and impenetrable jungle, with few inhabited or cultivated spots, the passage is very difficult. The political officer of Assam, Mr. Needham, after having had experience of one route, tried that by which in past times the Burmese armies used to find their way to conquer Assam. This leads across the Patkoi, among hills below 3000 feet in height, to Nongyong Lake, and then via the Loglai to the Singpho village of Ham Yung, thence to Ningbu, three short marches from Maingkhwan.

Australasia.—AUSTRALIAN EXPLORATION.—The news of Australian exploration is always tame and little varied, like the aspect of that "scrubby" interior. Dr. Lindsay and party crossed the space between the courses of Forrest and of Giles. They found the Queen Victoria spring on the latter course nearly dry, and the country seemed to have had no rain for two years. Various bushes were found, also a gum-tree forest which extended into S. Australia. From the roots of certain mallee trees, which the natives know by experience, they procure a quantity of pure water.

In South Australia the country between lakes Eyre and Amadeus has been explored, and seems to be rather more varied than most of the interior, as several ranges of hills, the Musgrave, Everard, Mann, etc., have been found, rising four to five thousand feet above the sea. The Musgrave hills are of red granite, which appears to predominate in the other ranges. Spinifex, a few pines, stunted gums and mulga, are the prevalent trees, but between the Musgrave and Mann ranges is a growth of large casuarinas.

In West Australia the country between Northam and Eucla has been traversed, and good ground has been found in a slightly undulating country. After the limestone was reached (31°, 10′ S., 124°, 30′ E.) the open forest and plains changed to grass and salt-bush plains, well adapted for pastoral purposes. Many holes were met with, probably leading to underground streams. The soil is mostly rich red loam, there are springs in many places, and water is near to the surface. White gum and gimlet-wood were the most conspicuous trees. The land seems rich in minerals. The natives seen were of much finer physique than those which frequent the towns.

NEW GUINEA.—Sir W. Macgregor continues his work of visiting the various tribes of British New Guinea with the aim of bringing them to acquiesce in the government and laws of Great Britain. Great progress has already been made in this matter, so that already some villages which were built upon piles for security are now removed to dry land. The want of recognized hereditary chiefs among the natives present causes some difficulty, but the coast tribes have to a great extent accepted the change, and the inland tribes, who were for the most part driven inland by the coast residents, are commencing to come in. The area of the British portion is 86,000 square miles, and the population is probably 350,000. On their part the Germans are doing similar work. Between Pouro and Milne bays there is a ridge of lava and coral limestone, rising to 850 feet. The close relationship often supposed to exist between the flora of New Guinea and that of Australia seems scarcely borne out by the facts. Though Proteaceæ and Myrtaceæ abound in the savannahs of Fly River, yet the palms are numerous in species, and at least fifty indigenous plants are known.

Sir W. Macgregor has been specially engaged among the D'Entrecasteaux and Trobriand Islands. The latter are a little known group of small islets, with one language, and a population of some 15,000.

The most interesting discovery has been that of a number of atolls which have, since their formation, been elevated by a horizontal uplift. Kitava or Nowan has a surface of 5.6 square miles, and is now girt by a fringing reef; almost its whole circuit is surrounded by a low sloping margin about a quarter of a mile wide, covered with trees. This abuts against a steep coral wall three to four hundred feet in height, also covered with forest. Within this wall the land dips gently to a plateau fifty to a hundred feet below the edge of the wall, plainly the ancient lagoon. The soil in this interior plain is of a rich chocolate tint, and very fertile. All the natives reside in this protected area, which is drained by filtration through the porous coral rock. Kwaiwata is similar, but much smaller. Gawa is a still more perfect specimen, having a coral wall four hundred feet high, and so steep that it must be climbed by ladders, while the interior is a 100 feet lower. On approaching these islands from the sea they seem to be uninhabited, since the natives live in the saucer-like hollow. In Iwa the raised border has been worn away. A great portion of the south of Fergusson Island, one of the D'Entrecasteaux group, is occupied by the mountain mass of Edagwaba, 4-5000 feet high, composed of mica schist, and in the N. W. corner Kubioia rises to 3–4000 feet. The islets of Namu and Bagiagia are of coral, low and uninhabited. On each of the small Trobriand Islands there is a single village.

Polar Regions.—THE DANISH EXPEDITION.—Lieutenant Ryder of the Danish navy, contrived in spite of the floating ice which extended from three hundred to three hundred and fifty miles from Greenland, to enter Scoresby Sound last year, and to discover that it was really an extensive fjord with several branches. Hurry's Inlet, a branch toward the north, proved to be a fjord 28 miles long, with gneissic cliffs 3000 feet in height on the east, and westward the crags of Jameson's Land, 2500 feet high, seemingly composed largely of glacial moraine. Many Jurassic and Tertiary fossils were found on Jameson's Land, while at Cape Brewster, where the cliffs rose only from 300 to 500 feet, fossils of older date were found.

The southern shore of Scoresby Sound presents a lofty and unbroken granite wall sixty miles in length, the ground rising in the interior to 3000 feet. The widest inlet is named Hall's Inlet, and trends northwest. On its shores are *roches moutonnées* and striæ in abundance, but no ice. The inland ice is not met with until a distance of 176 miles from the sea is reached, it is found at the heads of the smaller bays and fjords, and all the fjords seem to reach it. The gneiss rises to 500 feet in the southwest, to 3000 in Milne's Land (west of Hall's Inlet) and to 6000 feet in the northern region explored—on the west it is covered with basalt. Animal life proved to be rich, especially on Jameson's Land, where reindeer occurred in wonderful numbers, while the musk-ox was found on Hurry's Inlet. No less than 150 species of flowering plants were gathered. No inhabitants were met with, but winter houses and graves were seen.

POLAR NOTES.—Several whalers have left Dundee for the Antarctic, in the hope of combining discovery with a good catch.

Dr. Drygalski, in connection with the Geographical Society of Berlin, has erected an observatory between the Great and Little Karajak glaciers, on Umanak Fjord, West Greenland.

Coal has been discovered in Spitzbergen by L. Cremer.

GEOLOGY AND PALEONTOLOGY.

The Western Lowland of Ecuador.—A paper by Dr. Th. Wolf, read at the Berlin Geographical Society, Dec. 3, 1892, gives the following account of the Western Lowland of Ecuador:—

Its superficial area is 25,950 square miles. As late as the end of the Neocene period the waves of the ocean washed the foot of the Western Cordillera of Ecuador. At the commencement of the Plistocene period a part of the northern half of the lowland appeared above the ocean while the southern half was covered over by an immense sandstone formation. The latter, containing here and there the bones of mastodons and horses, was, at a very recent period, subjected to upheaval, which gave to the country very nearly its present configuration.

The great low-lying plain east and west of the Gulf of Guayaquil as well as the smaller alluvial plains, are quite recent formations, true deltas. The highest points of the coast ridge attain an elevation of 2,300 feet in a chalk range between Guayaquil and the sea, and in the Cordillera of Chongon and Colonche. In the Neocene region there are summits of from 650 to 1000 feet. The Plistocene marine strata form a gently undulating country rising from 65 to 260 feet above sea-level, while the extensive plain of alluvium is quite level. The rivers which issue from the Western Cordillera, do not flow due west; but, in consequence of the chalk range which runs north and south, form two extensive river systems, Rio Guayas emptying into the Gulf of Guayaquil, and Rio Esmeralda, flowing without a delta into the sea at 1° N. latitude. (Geog. Journ. Feb., 1893).

Devonian Fossils from Manitoba.—During the summer season of 1888 and 1889, Mr. J. B. Tyrrell made a collection of the fossils of the Devonian rocks of the islands, shores and immediate vicinity of Lakes Manitoba and Winnipegosis. This collection forms the subject of a report by Mr. J. F. Whiteaves, published by the Geological Survey of Canada. According to the author, this collection is one of the most important that have been brought back by the Survey collectors for many years. The species represented are of unusual interest, not only on account of the number of new forms, but also as showing the close relations that exist, in so many respects, between the fauna of these rocks and that of the Devonian rocks of Europe.

Mr. Whiteaves' report comprises 105 pages of text illustrated by 15 full page plates. The classification followed, with few exceptions, is that adopted by Dr. Karl Zittel in his Handbuch der Paleontologie. (Contributions to Canadian Paleontology. Vol. I, Pt. IV, 1892).

Jura and Trias in Taylorville, California.—Professor Hyatt gives the following preliminary results of an examination of four different collections of intervebrate fossils from the Jura and Trias of the Taylorville region in California.

A general comparison of the Trias of Taylorville with that of Idaho and of the Star Peak range in the Humboldt region, Nevada, shows that the Idaho Trias has a well marked Triassic fauna, with fossil cephalopods recognized in Europe by Mojsisovics, Steinmann and Karpinsky, as belonging to the lower part of the Triassic system. This fauna appears to be more nearly the equivalent of that of the Werferner beds of the middle Buntersandstein of the German Trias than of any other.

The Trias of the Star Peak range contains an unmistakably younger fauna. The species show a parallelism with the Muschelkalk instead of the Saint Cassian stage, as has been supposed.

The Trias of Taylorville is quite as interesting as that of the other two localities, and it is suggestive that its age, as indicated by the fossils, is that of the Noric and Karnic series in the upper Trias.

The Lower, Middle and Upper Jura, are represented by characteristic fossils which can be closely compared with representative European species. No remarkable or entirely new types occur, such as have been found among the vertebrata of this continent.

On comparing the Taylorville with that of Aurora, Wyoming, and of the Black Hills, it is found that the latter were deposited in the same basin, the species being largely identical, and that they can be spoken of together as having characteristice of the fauna of the Callovian or Oxfordian in the upper Jura of Europe.

The supposed Callovian of Mount Jura has no species in common with those of Aurora or the Black Hills. This accords with the distinct fauna of the Bicknell sandstone and the Hinchman Tuff, and would go to show that there was no direct connection between the upper Jurassic faunas of the Rocky Mountain region.

The Oolite of the Rocky Mountain region is too little known to permit comparison. Dr. White has described a few fossils found by Dr. Peale near the lower cañon of the Yellowstone in Montana.

The lower Lias, having certain forms of undeniably European facies, occurs in western and southwestern Nevada, and perhaps in California east of the crests of the Sierra. These faunas are older than those found at Mount Jura.

It is obvious that the Jura occurs in widely separated patches, and that, so far as now known, Mount Jura exhibits a larger number of fragments of the series of the Jurassic system than any other locality in the United States. (Bull. Geol. Soc. Am., Vol. 3, 1892.)

The Post-Laramie Beds of Middle Park, Colorado.—Mr. Whitman Cross, in a paper read before the Colorado Scientific Society in October, 1892, points out the unconformities that exist between the Middle Park Beds of Colorado and the underlying recognized Laramie formations, and calls attention to the difference in lithological characters. A study of specimens collected at different points show that a large series of andesite rocks strongly resembling those that constitute the Denver conglomerates take part in this formation. The Lignitic beds also resemble those of the Denver beds. In regard to the fossil plants Mr. Cross finds that 12 out of 21 species from the Middle Park beds occur in the Denver beds. These facts, the author believes, justifies him in correlating the Middle Park beds with the Denver, and he agrees with Mr. R. T. Hill in assigning them to the Post-Laramie group.

It has been suggested by Mr. J. B. Hatcher,[1] that in view of the fact that at least two species of Agathaumas have been described from the Denver beds, that it would be well to take into account the evidence from the vertebrate fauna before settling definitely the age of the beds under discussion. (Proceeds Col. Sci. Soc. 1892).

Marine Pliocene Beds of the Carolinas.—The tables of the Molluscan fauna of the Waccamaw and Croatan Beds of the Carolinas recently published by Dr. Dall, establish the presence of genuine Pliocene beds in both the Carolinas. The Pliocene of Tuomey and Holmes is shown to be based on a confusion of species belonging to at least two horizons, and hence the classifications based upon the supposed characters of this non-existent fauna may now be consigned to oblivion. (Trans. Wagner Free Inst. 1892.)

Geological News.—General.—Mr. Ralph S. Tarr has called attention to the resemblance between the terraces now forming on the

---

[1] Amer. Journal Sci., Feb., 1893.

Colorada River in Texas, and the older ones of the Connecticut River. He suggests that the modes of formation may be identical. In the one case the floods and sentiment supply arise chiefly from the climatic accident of desiccation, while in the other they are the result of glacial accident. (Am. Journ. Sci. July, 1892.)

M. E. Ficheur has added an important fact to the knowledge of the geology of northern Africa. He finds that on the northern flank of the Atlas Mountains in Blidah (Algeria), and throughout the extent of the region occupied by the Chiffa schists, there is an anteclinal fold affecting the whole sedimentary series, a fold long drawn out and turned toward the north. This phenomenon appears to be the result of a lateral thrust from the north against the resisting mass of the Chiffa schists which formed, to all appearance, an island in the Cretaceous Sea. This folding took place after the Cartéirenne period, and very probably after the Helvétien stage, for these beds are seen to be disturbed at the end of this range on the slopes of the spur on the left side of the Harrach. M. Ficheur is of the opinion that the folding is limited to the Blidah range. (Revue Scientifique, Feb. 1893.)

Paleozoic.—In his notes on the Devonian formation of Manitoba, Mr. J. F. Whiteaves remarks that in Manitoba the Stringocephelus zone is remarkably clearly developed, and holds a rich fauna, whereas in the Mackenzie River district, most of the fossils so far collected seem to be from the Cuboides zone. (Geol. Mag., Feb., 1893.)—Mr. Rollin Keyes calls attention to a well defined Kinderhook fauna intercalated in the Burlington limestone in northeastern Missouri. The fossils, chiefly molluscan, are found in a heavily bedded white encrinital limestone with a peculiar white chert in nodules and irregular bands. The forms are all species which characterize the Kinderkook of Burlington, Iowa. This seems to be an illustration of Barrande's celebrated " doctrine of colonies. " (Am. Journ. Sci., Dec., 1892.)

Mesozoic.—According to Mr. H. W. Fairbanks the granitic rocks of southern California are not Archean. They are present as intrusions squeezed into rocks varying in age from the Jurassic to Paleozoic inclusive at the close of the Jurassic. (Geol. Mag., Feb., 1893.)——Mr. A. Smith Woodward reports the skeleton of a fish from the Oxford Clay of Wiltshire, England, which he "provisionally quotes as an immature example of *Ischyodus egertonii.*" The fossil tends to confirm the reference of *Ischyodus*-like fishes to the existing family of

Chimæridæ. (Ann. Mag. Nat. Hist., Jan., 1892.)——The fossil fragments of jaws and teeth described by Gervais under the name *Lepidosteus suessoniensis* have been referred by M. V. Lemoine to the genus *Champsosaurus* Cope. M. Dollo has recently published a critical comparison of Gervais' Lepidosteus with Champsosaurus to show that there is no point of resemblance between them, but that they present numerous and radical differences, and that Gervais' reference is correct. (Bull. Scien. de la France et de la Belgique, 1892.)

Cenozoic.—Señor Nogués, who has been exploring the Andesian volcanoes of Chillan, confirms the supposition of Pissis (*Geografia fiscia de la Republica de Chili,* 1875, Paris) concerning the existence of moraines of two distinct epochs, and therefore of glacial periods, one of them being anterior to the present volcanoes. This explains the orography of the region. (Geographical Journal, Feb. 1893.)——Mr. G. Cotteau, who is studying the fossil echinoderms of the Eocene of France, has recently described a number of new species belonging to the genera *Coptosoma* (Desor), *Liosoma* (Cotteau), *Micropeltis* (Pomel) *Circopeltis* (Pomel), and *Gagaria* (Duncan). The latter genus is represented in France by six new species belonging to the middle Eocene. (Revue Scien., Jan., 1893.)——Professor Cope recently exhibited to the Academy of Philadelphia a nearly entire mandible of the *Tetrabelodon shepardii* (*Mastodon shepardii* Leidy) from the Blanco (Pliocene) of Texas. He showed that it differs from the known species in the decurvation of the mandibular symphysis, which equals that of the corresponding part of the jaw of Dinotherium, but lacks the incurvature of that genus. He shows that the Mexican species formly referred to that species is distinct, and he proposed for it the name of *Mastodon oligobunis.*

BOTANY.

North American Fungi, Century XXIX.—Subscribers to Ellis & Everhart's North American Fungi were gratified recently by the receipt of the 29th volume of this great collection, with its neatly mounted and labelled specimens. It is one of the "miscellaneous" volumes, nearly all groups of the fungi being represented. Thus we find five Myxomycetes, among which is the new *Stemonitis virginiensis* Rex; the recently described *Peronospora echinospermi* Swingle; a dozen or so Uredineæ, some but recently described; *Erysiphe graminis* in fruit; many Pyrenomyceteæ, some Hymenomycetes, and a good many "imperfect fungi," the latter well represented by species of *Phyllosticta* and *Septoria*.—Charles E. Bessey.

New York Fungi.—A new and interesting distribution of specimens of fungi has been undertaken by Mr. C. L. Spear, of Alcove, N. Y., under the title of "New York Fungi." It is designed particularly to illustrate the work of the well-known mycologist, Charles H. Peck, who, in the capacity of State botanist, has for so many years been engaged in the study of the fungi of New York. Century I contains the following species: *Amanita cæsaria* Scop., *A. phalloides* Fr., *A. muscaria* L., var. *alba* Pk., *A. vaginata* Bull., *Tricholoma album* Schæff., *Collybia radicata* Relh., *Mycena galericulata* Scop., *M. leaiana* Berk., *Omphalia campanella* Batsch., *Pleurotus sapidus* Kalchb., *Clitopilus cæspitosus* Pk., *Naucoria pruinatipes* Pk., *Hypholoma aggregata* Pk., *H. sublateritium* Schæff., *H. candolleanum*, Fr., *Coprinus picaceus* Fr., *C. micaceus* (Bull.) Fr., *C. plicatilis* (Curt.) Fr., *Lactarius deceptivus* Pk., *Cantharellus floccosus* Schw., *Marasmius oreades* (Bolt.) Fr., *M. rotula* (Scop.) Fr., *Panus stipticus* (Bull.) Fr., *Schizophyllum commune* Fr., *Lenzites betulina* (L.) Fr., *Boletinus pictus* Pk., *B. porosus* (Berk.) Pk., var. *opacus* Pk., *Boletus subluteus* Pk., *Polyporus perennis* (L.) Fr., *P. sulphureus* (Bull.) Fr., *P. fumosus* (Pers.) Fr., *P. adustus* (Willd.) Fr., *P. pubescens* (Schum.) Fr., *P. applanatus* (Pers.) Fr., *P. fomentarius* (L.) Fr., *P. conchatus* (Pers.) Fr., *P. hirsutus* (Wulf.) Fr., *P. pergamenus* Fr., *P. versicolor* (L.) Fr., *Dædalea confragosa* (Bolt.) Fr., *D. unicolor* (Bull.) Fr., *Glœoporus conchoides* Mont., *Hydnum zonatum* Batsch., *H. graveolens* Delast., *H. coralloides* Scop., *Irpex paradoxus* (Schrad.) Fr., *Phlebia zonata* B. & C., *P. radiata* Fr., *Craterellus cornucopioides* (L.) Fr., *Thelephora schweinitzia* Pk., *Stereum rugosum* Pers., *S. acerinum* (Pers.) Fr., *Hymenochœte corrugata* (Fr.) Lev., *Corticium salicinum* Fr., *Cyphella tiliœ* (Pk.) Cke., *C. fulva* B. & Rav., *Clavaria botrytis* Pers., *C. formosa* Pers., *C. stricta* Pers., *C. fusiformis* Sow., *Spathularia flavida* Pers., *Guepinia spathularia* (S.) Fr., *Lycoperdon gemmatum* Batsch., *L. pyriforme* Schæff., *Scleroderma vulgare* Fr., *Phragmidium subcorticium* (Schrank.) Wint., *Puccinia peckiana* Howe, *P. graminis* Pers., *P. circœœ* Pers., *P. pimpinellœ* (Strauss) Lk., *P. sorghi* Schw., *P. malvacearum* Mont., *P. mariœ-wilsoni* Clint., *P. fusca* (Relh.) Wint., *P. podophylli* Schw., *Uromyces junci* (Desm.) Tul., *U. polygoni* (Pers.) Fckl., *U. hyperici* (Schw.) M. A. Curt., *Rœstelia lacerata* (Sow.) Fr., *Æcidium clematidis* DC., *Ustilago caricis* (Pers.) Fkl., *U. avenœ* (Pers.) Jensen, *U. erythronii* Clint., *U. utriculosa* (Nees) Tul., *Sphacelotheca hydropiperis* (Schum.) Schrot., *Urocystis waldsteiniœ* Pk., *Microsphœra alni* (DC.) Wint., *Hypocrea richardsoni* B. &. M., *Hypomyces lactifluorum* Schw., *Diaporthe acerina* (Pk.) Sacc., *Hypoxylon fuscum* Fr., *H. blakei* B. & C., *Pezicula carpinea* (Pers.) Tul., *Cenangium cerasi* (Pers.) Fr., *Patellaria rhabarbarina* Berk., *Sphinctrina tigillaris* B. & Br., *Monilia fructigena* Pers., *Coniosporium rhizophilum* (Pr.) Sacc., *Trimmatostroma americanum* Thüm., *Septoria œnotherœ* West.—Charles E. Bessey.

Seymour and Earle's Economic Fungi.—The fifth fascicle of this set was distributed February 1st, 1893. It includes numbers 201 to 250, represented chiefly by Uredineæ parasitic on woody plants, many numbers (226 to 250) being devoted to the gymnosporangia, with their aecidial stages. Accompanying the set is a systematic list of hosts, from which one learns that the 50 species of fungi are parasitic upon 35 hosts, representing 13 families of flowing plants.

Of the usefulness of this set to students of the injurious fungi, little need be said. It is simply indispensable.—Charles E. Bessey.

Halsted's Weed-Seeds.—One of the most useful sets of specimens recently distributed is the "One Hundred Species of American Weed-Seeds," issued by Dr. B. D. Halsted, of New Brunswick, N. J. It consists of 100 small screw-capped vials, each containing a good quantity of cleaned seeds or achenes, in the condition in which they usually occur as impurities in horticultural and agricultural seeds. It supplements most admirably the two centuries of "American Weeds," issued by the same author.—Charles E. Bessey.

Morong's Naiadaceæ.—Students of the *Naiadaceœ* will be greatly helped by the sets of named specimens which Dr. Thomas

Morong, of Columbia College, is now distributing to subscribers. A set recently received contains 83 North American and European species and varieties, representing quite satisfactorily this difficult group. When the author's "Revision of the North American Naidaceæ," now in the press, is received, there will be little reason for students and collectors neglecting these interesting acquatics.—CHARLES E. BESSEY.

Canadian Mosses and Lichens.—Several years ago, Dr. John Macoun began the distribution of sets of "Canadian Musci," from material secured in his extensive collecting expeditions in the vast forests of the north and west. During the winter the fifth century came to hand, including numbers 501 to 600, some of which are interesting new species.

With this century of mosses came Century I of "Canadian Lichens," which promises to be fully as interesting a distribution as the other. The specimens are ample, and the labels are of the same neat style as those of the mosses.—CHARLES E. BESSEY.

ZOOLOGY.

The New England species of Balanoglossus.—In 1873, Alex. Agassiz described a Tornaria from New England which he ascribed to the common Balanoglossus of the region. Bateson later, studying in Virginia and North Carolina, showed that in *B. kowalevskii* there is a direct development. The question at once arose, what form did Agassiz have? Either his Tornaria did not belong to *B. kowalevskii* or the same species has a different development in different regions. Now Prof. T. H. Morgan announces[1] that he has found Bateson's larvæ with the *Balanoglossus kowalevskii* on the southern coast of New England. This clears up one problem but it still leaves the origin of the Tornaria questionable.

Marsipobranchs.—Beard reports[2] that in young Myxines in which the pronephros was functional, the teeth were present in several rows upon the roof of the mouth. Apparently there is no Ammocete stage, but there is a metamorphosis. He further finds that at least in one specimen of a male Petromyzon in about one section in forty of the testis there was a well marked ovum, occupying a follicle for itself.

The Lateral Line of Siluroids.—Pollard has been tracing the cephalic divisions of the lateral line system in several Siluroids[3] and while his work is largely descriptive and admits of no abstract, one is struck with the support he brings to the old view of Huxley that the Arthrodira are near relatives of the Siluroids and especially to the close affinities of Clarias and Coccosteus. The parallels in the canals of the two forms are very exact. On the other hand Pollard points out a close resemblance between the African genera Clarias and Auchenaspis and the South American, Chætostomus. The facts remains, that while careful studies of the lateral line like these of Pollard may in future throw much light upon the phylogeny of various groups of fishlike forms, we have as yet not data enough for much generalization.

Prodromus of a new System of the non-venomous Snakes.—The unsatisfactory character of the existing classifications of the

---

[1] Zool. Anz. XV, 456, 1892.

[2] Anat. Anz. VIII, p. 59, 1892.

[3] Zoolog. Jahrbüches, VI, 1892.

non-venomous snakes is well known. That authors are not agreed
to the principles on which these animals should be classified may
learned by comparison of the systems published by Duméril and Bibr
in 1853, Günther in 1858, myself in 1886 (Proceeds. Amer. Phil
Society), and Boulenger in 1892 (Reptilia of Zoology of British Indi
It had appeared evident to me that a further examination of the an
omy of these reptiles is necessary before a correct account of th
mutual relations can be given, and that the organs of the reproducti
system especially, were likely to yield important results. With t
object of obtaining light on this question, I have made an examinati
of the hemipenis, and have obtained valuable indications of relationsh
which have been hitherto unknown. I have had the opportunity
examining material from the collections of the Academy of Philadelph
of the U. S. National Museum, and of my own cabinet. I present he
a general synopsis of the results, reserving for a future occasion t
publication of a fuller illustrated memoir on the subject. The resulti
classification is more in harmony with the systematic indicatio
obtained from the study of other vertebrata, than those hitherto adopte
which is itself an indication of its greater approximation to natu
Some points remain obscure, and many details are omitted from t
present prodromus.

The hemipenis of the Ophidia is traversed by a groove which divid
the muscular investment to the internal integument (or external inte
ument when the organ is retracted), which commences at the ba
internally, and soon turns to the external side of the organ and co
tinues to its extremity. This is the sulcus spermaticus. This sulcus
always bifurcated in venomous snakes, and I find it to be equally bifu
cated in many harmless snakes. The investing tissues may or may n
correspond with this bifurcation. Thus the hemipenis may be more
less bifurcate. Schlegel states that it is bifurcate in venomous snak
but it is not so in *Hydrophis hardwickii*, *Bungarus semifasciatus*, *Hop
cephalus coronatus*, etc., while it is bifurcate in many non-venomous for
Next to the bifurcation of the sulcus in importance, is the nature of t
surface of the external investment (internal when retracted). In t
most perfect types both venomous and non-venomous, this surface
reticulate like tripe, the enclosed areas forming calyces, which may ha
a suctorial function. Their borders are generally papillose, and a
sometimes so deeply divided into papillæ as to lose their original cha
acter. These papillæ may be the seat of osseous deposit, becomi
bristles or spines, which become larger toward the middle of the lengt
and lose their mutual membranous connections. These isolated spi

may extend to the apex, but they rarely extend to the base. The surface may, however, be laminate and not recticulate, and the laminæ may be longitudinal or transverse. In either of these cases they may not be spiniferous. The apex or apices of the organ may be furnished with a rigid papilla or awn. The entire surface of the organ when protruded, is designed for the maintainance of its position in the oviduct of the female, from which it cannot be withdrawn, excepting by invagination.

In the Tortricina and Peropoda, the hemipenis is not spinous, and the sulcus is bifurcate, and in the Boidae the hemipenis is bifurcate also, although in some genera (Xiphosoma, Ungualia), the branches are very short. The external integument is never reticulate, but is always laminate with elongate papillæ at the extremities, in Epicrates, Xiphosoma, and Ungualia. The laminae are pinnate from the sulcus as an axis, in Morelia, Enygrus, Lichanura and Eryx, and are transverse in Charina. In Ilysia they are pinnate, with a few longitudinal plicæ below.

The general definitions of the families exclusive of the Peropoda are as follows.

No spines; surface longitudinally plicate;	*Calamariidæ.*
The surface of the hemipenis is flounced more or less transversely;	*Lycodontidæ.*
The surface is more or less reticulate, and the sulcus spermaticus is undivided: hypapophyses anterior;	*Colubridæ.*
The surface is reticulate or longitudinally plicate, and the sulcus is divided; hypapophyses anterior;	*Xenodontidæ.*
The surface is neither reticulate nor flounced, and the spines when present are disconnected; hypapophyses continued to caudal vertebræ;	*Natricidæ.*

The Calamariidæ approach in the characters of the hemipenis to such Peropoda as Eryx. The character assigned to the Lycodontidæ is more or less distinctly present in the typical or Solenoglyph venomous snakes; while the Najidæ (exclusive of Elapidæ) on the other hand, cannot be distinguished from the Xenodontidæ, by any general character. The Lycodontidæ are Old World with a single genus in America; a distribution resembling that of the Pythonidæ. The Colubridæ inhabit the Old World and North America, a few genera entering South America. The distribution is like that of the firmisternial Salientia. The Xenodontidæ are of South America and Madagascar, a few genera entering Africa and North America, a distribution nearly like that of the Iguanian lizards. The Natricidæ are distributed in the Northern Continents, very few types occurring in Africa and none in South America.

It will be observed that all of the families include burrowing types, and that the Colubridæ and Xenodontidæ include also arboreal types. This result is in accordance with the general rule that adaptations to present environment are not indications of the deepest affinities. All the families include glyphodont genera. The genera included in these families are the following:

CALAMARIIDÆ.

In *Calamaria gervaisii* the plicæ are well developed. Species formerly referred to Simotes belong here. In *Holarchus*[4] (Cope) *ancorus*, the sulcus is undivided, and the distal part of the external side is membranous. In the *H. trinotatus* the sulcus and hemipenis are shortly bifurcate, for which reason I refer it to a distant genus under the name of Dicraulax. I have had access to very few types of this group, and consider the present arrangement provisional.

LYCODONTIDÆ.

I. Aglyphodont; sulcus spermaticus undivided.

No palatine or pterygoid teeth. (In *Oligodon subquadratus* the only species of the genus examined, there are two robust papillæ on the extremity of the hemipenis); *Oligodontinæ.*

Hemipenis simple; palatine and pterygoid teeth; *Lycodontinæ.*

II. Aglyphodont; sulcus spermaticus, and generally hemipenis, bifurcate; *Boodontinæ.*

III. Glyphodont; sulcus and hemipenis bifurcate; *Cantoriinæ.*

IV. Glyphodont; sulcus simple; *Uriechinæ.*

To the Lycodontinæ belong Lycodon and Anoplophallus (=Megalops Hallow.) which has a long loreal and no preocular plate, and no spines on the hemipenis. To the Boödontinæ belong Boödon and Lamprophis; to the Uriechinæ, Uriëchis and the sole American genus, Stenorhina. The typical genus of each of the other subfamilies are the only ones I have been able to examine. The Oligodontinæ may belong to the Calamariidæ.

COLUBRIDÆ.

The subfamilies are as follows:

Aglyphodont; hemipenis reticulate; *Colubrinæ.*

Glyphodont; reticulate; *Dipsadinæ.*

Glyphodont; longitudinally laminate; *Chrysopeleinæ.*

The Colubrinæ are either burrowing (fusiform), terrestrial (colubriform), or arboreal (attenuate), and are so grouped for convenience.

---

[4] Bulletin, U. S. Natl. Museum, 32, 1887, p. 54.

Fusiform. Chilomeniscus; Ficimia; Geagras; Cemophora; Rhinochilus; Conopsis (has papillæ at the apex in addition to a few cups).; Stylosoma (spinous nearly to apex.)

Colubriform. Contia; Hypsiglena (pocketed below apex); Proterodon; Dianodon; Coronella; Ophibolus; Rhinechis; Phyllorhynchus (four rows of spines dividing calyculate apex); Salvadora; Symphimus; Epiglottophis; Pityophis; Spilotes; Coluber; Bascanium; Drymobius; Zamenis; Ptyas; Herpetodryas; Cyclophis; Liopeltis; Cynophis (has a terminal papilla which is produced into an awn); Crossanthera, (g. n.) established for *Deudrophidium melanotropis* Cope, on account of the total division of the walls of the small cups into papillæ.)

Attenuate. Dendrophis; Leptophis; Bucephalus; Dasypeltis (papillæ spinous to apex.)

In the Dipsadinæ the same gradation appears.

Fusiform. Tantilla; Scolecophis; Ogmius (spines to apex).

Dipsadiform; (generally pocketed below apex). Sibon; Trimorphodon; Crotaphopeltis; Himantodes; Rhinobothryum; Dipsas.

Attenuate. Cladophis; Oxybelis; Dryophis (has a diverticulum simulating a bifurcation of the hemipenis); Tragops; Passerita.

The Chrysopeleinæ includes only the genus Chrysopelea, so far as I have examined.

Genera of Colubridæ in which the calyces are not papillose, are Phyllorhynchus, Hypsiglena, Dianodon, Proterodon, Coronella, Symphimus, Dendrophis, Crotaphopeltis and Dipsas.

XENODONTIDÆ.

The arrangement of the genera of this family is difficult, and what is presented here is only tentative. It seems probable that some genera with a grooved posterior tooth are more nearly allied to others with a smooth tooth than to each other; but on the other hand the external form of the animal is a poor guide, as all forms pass into each other. So also the reticulate or plicate character of the integument of the hemipenis. Many of the genera may be distinguished by details of structure. As before, I designate the general forms as fusiform, colubriform, attenuate, and dipsadiform; and for the present I adopt two subfamilies.

Aglyphodont;	*Xenodontinæ.*
Glyphodont;	*Scytalinæ.*

Xenodontinæ.

Fusiform. Catostoma; Carphophiops; Farancia* †; Pseudoeryx; Ninia.

Colubriform. Homalosoma†; Grayia; Theleus g. n.; Diadophis; Rhadinæa; Pliocercus; Opheomorphus*; Liophis*; Dromicus; Alsophis; Lianthera g. n.; Hypsirhynchus*; Amastridium; Helicops; Xenodon*; Acanthophallus†; Lystrophis*; Heterodon.

Attenuate. Uromacer.

Dipsadiform. Leptognathus†, Mesopeltis†.

The genera of this subfamily in which the surface is exclusively longitudinally plicate are marked with a star; on the other genera it is more or less reticulate. The genera in which the extremity is spinous are marked with a †. In Theleus the hemipenis is simple, and its apex is covered with short separate papillæ, below which it is coarsely spinous; type *Boodon virgatum* Hallow. from W. Africa. Lianthera is established on *Herpetodryas bernieri* of Madagascar, and related species, on account of the absence of calyculi, and weak development of spines of the hemipenis, and the isodont dentition. The genus Acanthophallus is designed to include the species formerly referred to Xenodon in which the hemipenis is spinous to the extremity. The type is *X. colubrinus* Gthr; the anal plate is entire. In Xenodon the extremity is smooth and plicate, and the anal plate is divided.

SCYTALINÆ.

Fusiform. Hydrocalamus.†

Colubriform. Pseudophis; Erythrolamprus*; Tachymenis†; Coniophanes; Conophis; Rhinostoma; Scytale; Oxyrrhopus; Tomodon†; Thamnodynastes (includes *Tachymenis hypoconia* M.), Tropidodryas; Philodryas; Jaltris.*

Attenuate. Langaha.

As in the Xenodontinæ, genera with the apex plicate only are marked with a star, and those with a spinous apex are marked with a dagger. The only species of Tomodon I have examined is the *T. ocellatus*, which is not the type. The position of Langaha I am not satisfied about, as it may be an attenuate form of the Natricidæ.

NATRICIDÆ.

This family, which I first defined from vertebral characters, is generally easily distinguished from the others by the characters of its hemipenis. This organ is never reticulate, and the spines are always small or rudimental. When present they originate in fossæ of the integument and are never connected by tegumentary folds, except when they sometimes stand on longitudinal plicæ. The aglyphodont genera (except the Pseudaspidinæ) make up for the deficiency of the spines, by the presence of one or two large hooks on one side of the sulcus spermaticus at the base. The sulcus is variable, being sometimes simple, and sometimes bifurcate. The subfamilies are as follows:

¶Glyphodont.	Spines better developed; no basal hook;	*Homalopsinæ.*
¶Aglyphodont.	Spines rudimental; no basal hook;	*Pseudaspidinæ.*
¶Aglyphodont.	Spines rudimental; a basal hook.	*Natricinæ.*

Of the HOMALOPSINÆ only the genera Homalopsis, Herpeton, and Cerberus have come under my observation; but I suppose that Hypsirhina and other allied Asiatic genera will be found to present the same characters. In both genera the sulcus is bifurcate, and the hemipenis divided.

I have been able to examine but one genus of the PSEUDASPIDINÆ, viz., Pseudaspis Cope (type *Coronella cana* L.), but I suspect that Ablabes (*A. rufulus*) which is African, belongs here. In Pseudaspis the sulcus is bifurcate, and the hemipenis is divided almost to the base, quite as in the most specialized Solenoglypha.

NATRICINÆ.

This natural group includes fusiform and colubriform genera, and presents great variations in the form of the hemipenis. The Asiatic species have that organ bifurcate, while in the European and American water snakes it is simple.

Fusiform. (Hemipenis simple). Haldea; Tropidoclonium (the apex with a pair of robust papillæ as in Oligodon;) Virginia.

Colubriform. I. Sulcus and hemipenis undivided. Storeria; Eutænia; Natrix; Clonophis; Liodytes. II. Sulcus and hemipenis divided. Diplophallus, g. n. (type *Tropidonatus piscator* Schneid.; has syncranterian dentition, and no apical papilla); Amphiesma; Ceratophallus (established on *Tropidonotus vittatus* on account of the presence of a rigid papilla on the apex of each branch of the hemipenis.)

Similar gradations in the characters of the hemipenis are to be seen in the types of venomous snakes. Thus in the Proteroglypha this organ is spinous to the tip, on a calyculate basis, in Hydrophis, Elaps, (*surinamensis*); Dendraspis. It is reticulate at the extremities and spinous below, in Callophis (*bivirgatus*); Naja; Acanthophis; Bungarus and Sepedon; the apex smooth in the two genera last named. In *Elaps nigrocinctus* the organ is usually smooth, with a few spines at the apex.

In Solenoglypha the genus Atractaspis is spinous to the apex, apparently on a longitudinally laminate basis. In the Viperidæ and Crotalidæ the spines are on a flounced basis. The apices are calyculate in Bitis, Clotho, and Vipera, and spinous in Cerastes. They are calyculate in Crotalidæ in Bothrops, Ancistrodon, Crotalophorus, Crotalus and Uropsophus. In Crotalus (*durissus* of the Neotropical fauna), the median spines are replaced by papillæ, in all the other genera they are spinous.—E. D. COPE.

Zoological News. PROTOZOA.—Prof. August Gruber, in a note on nuclear multiplication and swarm formation in the Freshwater Rhizopoda[5] describes an Arcella in which milotic cell division occurred. He also figures Arcella with 19 and 32 nuclei, and *Lecythium hyalinum* with eightnuclei. These facts are adduced in evidence that among the fresh-water Rhizopods reproduction by spore formation coexists along with simple fission. In other cases Gruber found small bodies in Arcella tests which at first sight might be taken for swarm spores but which are none other than parasitic Amoebæ.

WORMS.—Nachtrieb and Barrows are studying the leeches in Minnesota. In a preliminary note[6] Mr. Barrow states that they have found 11 species of Gnathobdellidæ, 10 of Rhynchobdellidæ and 1 of Branchiobdellidæ. It is noted that two species of Aulostoma can be distinguished by the fact that in the one the right sperm duct passes under the nerve cord; in the other the left. A final report is promised.

Henry B. Ward reports[7] the host of *Nectonema agile.*[8] Dr. McMurrich found a worm, like Nectonema except that it lacked the lateral bands of setæ, characteristic of the adult, in the thoracic cavity of Palæmonetes. This when studied by Dr. Ward, proved to be a female Nectonema.

MOLLUSCA.—H. Suter enumerates 142 species of land molluscs, 32 fluviatile, and 18 brackish water species, in New Zealand.

According to C. Hedley, *Parmacochlea fischerii* collected by the "Challenger" expedition is most nearly allied to Helicarion.

---

[5] Ber. Naturf. Gesellsch. Freiburg, VI, 114, 1892.

[6] Quarterly Bulletin, Univ. Minnesota I, p. 87, 1893.

[7] Proc. Amer. Acad. Arts and Sci. 1893, p. 260.

[8] See AMER. NAT. XXVI, 1037, 1892.

EMBRYOLOGY.[1]

Germ-layers of Vertebrates.[2]—Basilius Lwoff has extended his work upon the germ-layers of Amphioxus[3] to other vertebrates and put forth a preliminary paper that arouses in us a lively interest in the final detailed account that is to contain both his own discoveries and a discussion of the literature of the subject.

In the present paper he makes statements directly contrary to some opinions that up to the present time we have supposed to be well-founded in fact.

Besides Amphioxus, he has studied the formation of the germ-layers in Petromyzon, the Axolotl, Pristiurus, Torpedo, Labrax, Julis, Gobius, and Lacerta. He regards the Chordata as derived from a gastrula-like ancestor. Gastrulation is defined as the process by which the gut is formed, and the entoblastic cells are those which form the gut, whatever else they may produce. In Amphioxus and Vertebrates with holoblastic eggs, cleavage results in a blastula, one-half of which is composed of micromeres, the other of macromeres. Owing to the continued more rapid multiplication of the micromeres, they cover and grow around the macromeres. When the blastula is single layered, as in Amphioxus, this results in the invagination of the macromeres, where it is several layered, as in Petromyzon and the Amphibia, they are simply surrounded by the micromeres.

The macromeres form the gut and are therefore entoblast, while the micromeres form the outer covering and are therefore ectoblast. But there can be no distinction between entoblast and ectoblast until the micromeres have surrounded the macromeres. Besides this process of gastrulation there is a *dorsal invagination* that has nothing to do with the formation of the gut, but forms the whole ectoblastic rudiment of the chorda and the mesoblast.

The blastula of Petromyzon contains an extensive cleavage cavity, the roof of which is composed of micromeres and the floor of macromeres. The former multiplying more rapidly, grow around the latter. At the same time a new cavity is sunk into one side of the embryo, the roof being formed of invaginated ectoblast, while the floor is composed of entoblast that has not been invaginated. As in Amphioxus, this invaginated ectoblast forms the chorda and part of the mesoblast, while the entoblast forms the rest of the mesoblast as well as the gut.

---

[1] This department is edited by E. A. Andrews, Johns Hopkins University.

[2] Biol. Centblt. 13, 1893, 40–50, 76–81.

[3] See AMERICAN NATURALIST, March, 1893, p. 228.

Nearly the same process, according to Lwoff, takes place in the Axolotls. But here the dorsal invagination begins, while the micromeres are growing over the macromeres, and the ectoblastic rudiments of the mesoblast never form part of the roof of the enteric cavity. In the frog, however, Morgan[4] and Robinson and Assheton[5] seem to have found good evidence that the micromeres do not grow around the macromeres, but that the superficial ones of the latter are themselves gradually split up into micromeres, so if we are to accept Lwoff's interpretation of the dorsal invagination, the gastrulation in this form may better be described as being by delamination than by an epibolic process. Moreover, according to the apparantly accurate work of Robinson and Assheton, there is no invagination of the ectoblast in the frog.

In Selachians and Teleosts, Lwoff believes the entire entoblast arises from the yolk-elements, that is, the periblast. This is surprising in view of the many statements to the contrary, especially H. V. Wilson's[6] work on the sea-bass. Lwoff finds the chorda and part of the mesoblast to be formed from the same elements as the nervous system. The entoblast also takes part in the formation of the mesoblast.

In Lacerta, cleavage results in a two layered germinal disc. The inner layer becomes the entoblast. An invagination from the outer layer forms the chorda and part of the axial mesoblast. The rest of the axial and the peripheral mesoblast is of entoblastic origin.

The process in the formation of the germ layers throughout the Vertebrates is practically the same as in Amphioxus, except that there is no invagination to form the entoblast, and there are, therefore, no gastrula lips. There is but one point in the embryo that is homologous in all Vertebrates, and that is the point where the ectoblastic invagination begins. The so-called neurenteric canal does not lie between the neural canal and the archenteron, but between the former and the chorda, and shows their intimate connection—R. P. B.

The Mantle of Ascidians.—In studying live specimens of larval Phallusia, A. Kowalevsky[7] at first thought with Hertwig, Semper, Maurice and others, that the mantle of this ascidian should be regarded as an epidermis-like structure, a thickening of the ectoderm with large amounts of intercellular material between the ectodermal cells.

---

[4] AMER. NAT., Aug., 1891, p. 753.

[5] Quart. Jour. Mis. Sci., 32, 1891, p. 451.

[6] Bul. U. S. Fish. Com., 9, 1891, p. 209.

[7] Mem. l'Acad. Imp. Sci. St. Petersburg, 7, 37, No. 10, 1892.

On studying sections of this larva, however, he obtained evidence that mesodermal cells migrate out through the epidermis of the larva into the thick hyalin cuticle or secreted mantle matrix, and thus supply mesodermal cells as the fundamental cells of the mantle.

These migrating cells the author would regard as a sort of phagocytes and imagine to have a primary function in destroying the injurious parasites, bacteria, etc., that would easily lodge in the secreted mantle matrix.

In the same paper there is an interesting account of the degenerative changes that the tail of the larva undergoes when free life is given up. After peculiar histological transformations in the notachord and muscles of the tail, these cells and the epidermal cells pass into the body. The last of the tail is drawn in by an actual hollow invagination that forms a closed vesicle in the body. The ultimate changes in the muscle cells are accompanied by the activity of clusters of phagocyte-like mesoderm cells.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 5.—The following paper was read by Professor George Lincoln Goodale: "On some aspects of Australian vegetation." It was illustrated with stereopticon views.

Samuel Henshaw, *Secretary.*

New York Academy of Sciences. Biological Section.—March 13, 1893.—Professor T. D. Quackenbos, in a paper on the Saibling of Lake Sunapee, distinguishes, in this, a fourth variety of New England Charr, demonstrating that the present abundance of this *Salvelinus* is accounted for not from its introduction and natural increase, but from destruction of inimical forms within recent years which has given a greater available food supply. Professor G. S. Huntington, on "Anomalies of Pectoralis major and minor," referred to the value of these as often presenting reversions. He emphasized the evolutionary tendency in man to proximalization of the points of attachment of the shoulder muscle group, referred to cleavage variations in anterior portion of brachiocephalic sheet, and compared these with ontogenetic characters in Anthropoids. Human anomalies in this group are best interpreted by Cynocephaloids, and not by the higher forms. Professor E. B. Wilson, "On Regeneration and the Mosaic Theory of Development," presented a brief critique on the latest results of Rous and Weissman.

Bashford Dean, *Secretary.*

Natural Science Association of Staten Island.—February 18.—A series of twenty photographs of Staten Island trees were shown by Dr. N. L. Britton—duplicates of the set taken by Mr. Romeyn B. Hough, for the State Forestry exhibit at the Columbian Exposition, as mentioned at the meeting of October 15, 1892.

Mr. Joseph C. Thompson stated that since the last meeting he had made another bacteriological examination of the Crystal Water Company's water, from a sample taken from a hydrant at the corner of New York Avenue and Cliff Street, and found 185 individual bacteria per cubic centimetre. The temperature of the water was 34° Far. As previously stated, the New York City Croton water contains about 12,000 per cubic centimetere.

Mr. Arthur Hollick presented a piece of ferruginous sandstone, containing impressions of dicotyledonous leaves. The specimen resembles those found in the Drift, at Tottenville and Princes Bay, which are known to be derived from the Cretaceous clays. The specimen in question, however, was found as a Drift rock on the Serpentine hills, to the north of the Cretaceous area. It is possible that it may have been brought to the place where it was found by human agency, but if not, its occurrence there is more or less of a problem which future discoveries may solve. It is desired, at present, merely to place the fact upon record.

The Biological Society of Washington.—March 11.—The following communications were made: Dr. Frank Baker, "Recent Discoveries in the Nervous System;" Mr. Vernon Bailey, "The Burrow of the Five-toed Kangaroo-Rat;" Mr. E. M. Hasbrouck, "The Breeding of the Bald Eagle near Mount Vernon"—with exhibition of Eggs.

March 25.—The following communications were made: Mr. L. M. McCormick, "A Hybrid between *Pyranga rubra* and *Pyranga erythromelas*;" Prof. E. W. Doran, "Development of the Intestine of Tadpoles;" Dr. Theobald Smith, "The Bacteriology of Potomac Water and its Bearing on Sanitary Problems;" Mr. B. T. Galloway, "Experiments in Preventing Rusts Affecting Cereals."

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—Feb. 21.—The following papers were read: "The Foundation of the Zuni Cult," Mrs. Matilda Coxe Stevenson; "Dual Civic Functions: a study in the evolution of institutions," Miss Katie Foote; "Early Man in the Mississippi Valley," Mr. Thomas Wilson.

WESTON FLINT, *Sec'y Board of Managers.*

SCIENTIFIC NEWS.

At the meeting of the Geographical Club in the Hall of the Academy of Natural Sciences of Philadelphia, it was announced that the result of the balloting among the members of the club upon the question of active co-operation in the proposed new expedition to the Arctic regions under the lead of Lieut. R. E. Peary, stood in favor of the project.

The proposed expedition will involve an expenditure of from $20,000 to $25,000. The expenditure covers two northern voyages. The first to land Peary and his party, and the second to bring it back upon the completion of its work. An auxiliary summer expedition is to be organized to take charge of the ship on her second voyage, the movements of the vessel to be under the control of the Geographical Club.

The design of the expedition is the complete determination and delineation of the detached land masses lying to the north of main Greenland. The second object will be the determination of the unknown portion of the east coast of Greenland, extending from Independence Bay to Cape Bismarck, the most northern point sighted by the German expedition in 1870. The third object will be the determination of the transverse profile of the Greenland inland ice cap, from Cape Bismarck to Inglefield Gulf.

Other aims of the expedition will be the complete detailed survey of Whale Sound and Inglefield Gulf, with studies and measurements of the glaciers in that region, and their parent ice cap; a continuation of the study of the little tribe of Arctic Highlanders. As complete collections as may be practical will be made of the natural objects of the region, and more or less extended meteorological and tidal observations carried on.

The amount of funds to be contributed by the Geographical Club will be from $8,000 to 10,000.

Botanists will hear with regret of the death at Brighton, Jan. 18, of Dr. Benjamin Carrington, the highest authority on British Hepaticæ.

The State of Iowa has assumed the expense of the publication of the papers and proceedings of its Academy of Sciences, the Legislature having made an appropriation for that purpose at its last meeting.

Professor A. M. Miller has been appointed to take charge of the department of Geology which has just been established in the State College of Kentucky, at Lexington.

Mr. John Eyerman has presented to the Princeton Museum a set of casts of *Rhytina gigas* Linn., after the originals in the British Museun. The number of casts is 20, that of the cranium, measuring 2½ feet, being the largest.

M. Johnston-Lavis has been appointed Professor of Vulcanology at the University of Naples. A similar chair existed at Catania, but it was abolished at the death of its occupant, M. Silvestri.

Mr. G. W. Lichtenthaler, one of America's most eminent conchologists, died in San Francisco. Feb. 20, 1893. For 20 years he had been a traveler and collector in almost every sea and country. During this time he brought together a large collection of specimens, which he bequeathed to the Illinois Wesleyan University, in his home city, Bloomington, Ill.

The collection embraces mainly shells, sea algae and ferns. His shells have been estimated conservatively at from six to ten thousand species, including thousands of duplicates. They embrace the Hemphill collection which he purchased, a large collection from the Hawaiian Islands, which he visited often; many from the Micronesia, Australia, Japan, the coasts of Europe, and America, and from every part of the United States.

The sea algae contain about a thousand species, all mounted in books and identified, and a large number of duplicates. They were collected from both coasts of America, from north to south, a large number from England, and many from other countries.

There are about 500 species of ferns, including the many duplicates. They represent a complete collection of the ferns of the Hawaiian Islands, and almost a complete collection of those of the United States, besides many from Europe, Asia, Australia, South America, etc.

He has also brought together many mosses and lichens, the number of which cannot be given with precison, but there are several hundred species.

The Marine Biological Laboratory of the Johns Hopkins University will be located this Summer at Port Henderson, Kingston Harbor, in the island of Jamaica.

Dr. R. P. Bigelow, present holder of the Bruce Fellowship with Messers Lamb, Siegirfuss and Lefevre left Baltimore, April 20, by a fruit steamer for Port Antonio, whence they will go to Kingston to open the Laboratory. Others with the Director, Professor W. K. Brooks expect to go down there later.

CAMBRIDGE, MASS., April 15, 1893.

THE Faculty of the MUSEUM OF COMPARATIVE ZOOLOGY will receive applications from candidates desiring to occupy the table at the NAPLES ZOOLOGICAL STATION, which has been placed at its disposal from October 1, 1893.

The applicant must be (or have been recently) a student or instructor at some American University, preferably a person who has taken the degree of Ph.D. or S.D.; he must have published some creditable original investigation, and should be recommended as an able investigator by the professor under whom he has studied.

Applicants will please forward to the undersigned, before May 10 their recommendations and a statement of their qualifications and of the subject to which they hope to devote themselves.

In order that the Faculty may make the most satisfactory disposition of the table during the whole year, the applicants are requested to state the length of time they desire to remain at Naples, and also the earliest and latest dates within which they can avail themselves of the appointment.

The Faculty will, at its meeting in May, nominate to the Corporation of Harvard College for approval the incumbent or incumbents for the year 1893–1894.

ALEXANDER AGASSIZ,
Director.

The North American Review. Table of Contents for April, 1893.—*Charges at the World's Fair*—by Director-General Davis. Brain Surgery—Dr. William A. Hammond. Shipbuilding Here and Abroad—Naval Constructor Hichborn, U. S. N. Good and Bad Mothers—Mrs. Amelia E. Barr. *How Shall the Pension List be Revised?*—by Representative Wilson, of Missouri, Chairman of the Committee on Pensions; Gen. S. S. Burdett, Past Commander-in-Chief of the Grand Army of the Republic, and Col W. C. Church, editor of the "Army and Navy Journal." Art of Mystery in Fiction—George Manville Fenn. The Interior of the Earth—George F. Becker, of the United States Geological Survey, Two Englishwomen on America—1. by Lady Grey-Egerton; 2. by Lady Sykes. Faults in our Consular Service—the Hon. Robert Adams, Jr., Ex-Minister to Brazil. After Death—What?—the Rev. Charles F. Dole. The Negro as a Mechanic—the Hon. Robert Lowry, Ex-Governor of Mississippi. Middle-Class Life in France—the Marquise de San Carlos. *The Financial Situation*—1. The Currency and the Democratic Party—by the Hon. R. P. Bland, Chairman of the Committee on Coinage, etc.; 2. The Brussels Conference Reviewed—by the Hon. Charles Foster, Ex-Secretary of the Treasury. *Notes and Comments.*—"By Women for Women"—Lillian A. Mercur. Do the Fittest Survive?—W. A. Croffut. The Abuse of Secrecy—Clara Dixon Davidson. English Poor Law Reform—Edward Porritt.

RECEIVED
JUN 20 1893

THE
AMERICAN NATURALIST

VOL. XXVII. June, 1893. 318

RECENT RESEARCHES UPON THE SUCCESSION OF THE TEETH IN MAMMALS.

BY HENRY FAIRFIELD OSBORN.

While American paleontologists have been making rapid advances in the phylogenetic history of mammalian teeth, the English have made notable additions to our comparative anatomical knowledge, and the Germans to the embryogenesis. The recent studies of Kükenthal, Röse and Taeker in the discovery of the complete double or milk dentition in the Marsupials, and in the discussion of its relation to that of the reptiles, also in the ontogenesis of the crowns of the teeth among the Cetaceans, Edentates, Primates and Ungulates are of the greatest interest and importance. They involve a complete revolution in our ideas as to the interpretation of the dentition in the three orders first mentioned above.

The latter authors are perhaps inclined to lay too great stress upon the testimony of ontogenesis in the order of appearance and consequent homologies of the mammalian cusps, and Röse's work is to a certain extent rendered less useful by the fact that he has substituted the conclusions of ontogeny for those based upon the more certain foundations of phylogeny. It is a subject of congratulation, however, that these authors, who constitute the rising school in Germany, recognize the value of the paleontological work done in this country, and are ready to join hands in pushing forward these investigations upon a joint basis.

KÜKENTHAL'S RESEARCHES.

Kükenthal's studies upon toothed whales were partly directed upon the theory of Weber, Julin and others that these animals were formerly heterodont. In the embryo of the Porpoise (*Phocœna communis,*) he found traces of a heterodont condition quite sharply marked. There were twenty-five teeth in each half of the jaw, and the posterior seven were found to have two or three cusps. Having thus supported the opinion that the homodont toothed whales were primitively heterodont, Kükenthal has also proved that they are diphyodont, and that the dentition of the toothed whales is a true milk dentition, while the second or permanent dentition is represented by rudiments which display a distinct crown of enamel and even the enamel pulp, yet does not reach the surface.

In the whalebone whales in which germs of teeth had been found in the first third of foetal life, Kükenthal does not confirm the opinion of Weber that the dentition is heterodont. He denies that the posterior teeth are more complex than the nine anterior teeth, and holds that throughout they are simply conical, excepting in cases where two external teeth are fused together. This fusion of teeth does not follow any definite rule; in some cases it occurs in the anterior nine teeth. The course of embryonic development shows that these fused teeth represent an original condition, and in the opinion of the author, are to be regarded as molars. This conclusion was reached by the comparison of younger and older embryos, the number of fused teeth constantly diminishing in the latter.

Kükenthal advances the hypothesis that this was the method by which numerous homodont teeth arose from a small number of heterodont, namely, by the splitting apart of cusps. This hypothesis he promises to support by paleontological evidence. He also shows that these embryonic teeth in the whalebone whales also represent the first or milk dentition; and that the rudiments of a second series of teeth develop beneath them. Kükenthal refers these transformations in the dentition to natural selection, terminating with diminished calcification connected with the advantage of diminished specific gravity.

His general conclusions are, that all the earliest mammals were diphyodont. This is based upon his discovery of successional teeth in Marsupials, Edentates, Odontocetes and Mystacocetes. The monophyodont and homodont condition of many mammals, such as the toothed whales, he believes has been secondarily acquired. Within the higher members of the mammalian class the second dentition is developed progressively, both as regards form and function; while in the lower divisions, the first or milk dentition is predominant. "In the rudimentary stage both dentitions are of equal value. Embryology gives us no support for the often expressed assertion, that one of the two dental rudiments has arisen in dependence upon the other. They are both sisters, whose mother is the simple invagination in the jaw, which we term the dental fold, (*Zahnleiste.*)" He continues, that there are no absolute differences between mammalian and reptilian teeth; that not one of the characters of the mammalian teeth is perfectly constant, and that the derivation of the dentition of mammals from that of the reptiles does not appear to be too hazardous. Of the several series of teeth which are found in reptiles, only two persist in the mammals.

From this I would dissent in part. The three differences between the mammalian and the reptilian teeth are shown in the capacity for the multiplication of cusps upon the crown, in the division of the fang whenever the crown becomes multicuspid, in the acquisition of the cingulum. The frequent succession of teeth in the reptiles, may be the cause of the non-progression of reptilian as compared with mammalian teeth. In the reptilia among the Theromorpha, we find true triconodont crowns, as for example in *Galesaurus*, and a heterodont dentition which closely imitates that of the mammals; but the class differences appear in the fact that in the mammalia a development of lateral cusps upon the protocone, and the stages from the protodont toward the triconodont type, are marked step by step by the division of the fang. This law was advanced hypothetically by Cope and Wortman, and I regard it as absolutely proven by the evidence I have adduced in the study of *Dromotherium*, *Microconodon* and *Amphilestes.*

The hypothesis of Kükenthal and Röse that the numerous single pointed or homodont teeth of the whales, have arisen by the splitting up of the three cusps of a triconodont crown is an ingenious one, upon which paleontology at present throws no favorable light. *Amphilestes* of the middle Triassic with its seven triconodont molars, might by such a splitting process, furnish twenty-one homodont teeth; nevertheless this seems to me highly improbable; while the converse hypothesis suggested by Kükenthal and developed by Röse, that multicuspid crowns have originated by the fusion of single cusps, is capable of direct disproof by paleontological evidence.

The multiplication of teeth accompanying the elongation of the jaw in Cetacea, can be much more simply explained by the supposition that the dental fold was carried backward, and gave rise to new teeth caps at definite intervals. I may add that the rapid reduction of the molars in the Mesozoic period from behind forward, which reduced their number in the *Triconodontidæ* from seven to four, between the middle and upper Jurassic periods, is against the supposition that the *Amphilestes* molar, for example, furnished the material for the multiple Cetacean series.

Kükenthal's researches upon the dentition of the opossum, published in 1891,[1] mark another great step in advance in our knowledge of the dentition of the mammals. We may refer to the later researches of Röse for details, and simply quote one passage from Kükenthal:

"The permanent dentition of the Marsupials, belongs to the first series or milk dentition. Rudiments of the second dentition are actually present in an embryonic condition, but with the exception of the third premolar, they do not cut the gum." Again, the two first so-called true molars, of the upper jaw, and the first three similar teeth of the lower jaw, also belong to the first dentition and have rudimentary successors. Therefore, excepting the last upper and lower molars which appear at a late stage of development, neither dentition of *Didelphys* belongs to the so-called permanent series. This opinion has been somewhat emended by Röse.

---

[1] Anatomischer Anzeiger, Nos. 23, 24.

RÖSE'S RESEARCHES.

MARSUPIALS. Dr. Röse gives the following summary of his principal results. "When we combine the results of the foregoing researches, we find that the development of the teeth in the Marsupials follows exactly the same principle as that of man and the other mammalia. The first matrix is indicated by the dental fold, i. e. a part of the epithelium of the jaw which grows into the mesoderm aided by an extensive fold. Upon this dental fold are formed the dental caps which belong to the first series; in the case of *Didelphys*, the incisors, the canine, two premolars and the first molar. These dental caps are then immediately constricted off from the dental fold, and this ridge grows both inwards below the dental caps, and backwards behind the molar above mentioned. The posterior molars arise in exactly the same manner as I have described in the case of man, through lateral extension of the dental ridge.

" While, however, in the case of man, the permanent ridge extends beneath the ten anterior teeth constituting the milk series and gives origin to ten permanent teeth, which cause their predecessors to be absorbed, in the Marsupials only the last premolar of the adult arises from the dental ridge of the permanent teeth. It is nevertheless, more than probable that the outer (5th) incisors of *Perameles*, as well as of Macropus and Phalangista, are built up from the permanent ridge, i. e. they belong to the second dental series. The last upper premolar belonging to the second series in some cases simply pushes its way into a gap in the first series without causing the usual absorption of the first tooth in this row. This type we find to be shown in *Didelphys*, in *Perameles*, in *Phalangista cookii*, as well as in *Macropus*. In other cases the last premolar of the first series is absorbed, and in its place enters the premolar of the second series; this more primitive type is found in an undetermined species of the genus Phalangista; also in *Macropus lugens* and *M. gigantius*; also, according to the figures of Oldfield Thomas, in *Phascogale*, and in the fossil *Triacanthodon serrula*.

"Further researches are necessary to determine which type is the most common among the Marsupials. It also remains to ascertain through sections and models, whether the last incisor (fifth or lateral, i^5) of the upper jaw really arises from the second series, and in what species this occurs. Possibly in some Marsupials other teeth also rise from the second series. Whether this, however, is the case or not, the principal theory of Marsupial dentition is not thereby affected. It is certainly well established by my researches, as well as by those of Kükenthal, that the teeth of the Marsupials, with the exception of the last premolar and probably of the last superior incisor of some species, belong to the first series, and are analogous with the milk teeth of man and other mammalia.

"This shows that in the entire vertebrate series the principle holds good, that by the better development of the single tooth, the frequent succession of teeth of the Selachian type, is gradually limited. The Marsupials, however, in the reduction of the multiple succession of the reptilian-like ancestors of existing mammals, have together gone past the limit, and have wandered into a *cul de sac* of evolution out of which there was no return. Upon this rests the remarkable constancy of this order, from the Mesozoic period to the present time. The reduction of the former multiple succession of teeth of the vetrebates to a single series of teeth, appears therefore, only to be of service when the teeth at the same time attain a permanent growth. This stage was only attained among the Marsupials by *Phascolomys*."

In the same paper the author restates his theory of the origin of premolars and molars by the fusion of several single teeth, and is led far astray from the actual conditions which we observe in such development. Originally, he says, the premolars, like the molars, embraced three single cusps, which were arranged in the triconodont type; in Triacanthodon the premolars are altogether formed like the molars. (This observation is an error. The only Mesozoic mammal in which the premolars are even approximately similar to the molars, is *Phascolotherium.*) After the original three cusps of the premolars had been arranged in the triconodont order, he supposes, arose the degeneration of the forward cusp, leaving a tooth type which we observe especially among the Carnivora. (The cusps left here are simply the protocone and talon.)

In an earlier paper upon human dentition, the author is also led astray by ontogeny to false conclusions as to phylogeny, and at the conclusion of his extremely interesting paper upon the embryogenesis of the human dentition, he says: "The typical form of upper molars in man is unquestionably the four cusped type; while the typical form in the lower molars is the five cusped type."

EDENTATES. Dr. Röse has also contributed interesting observations upon the rudimentary development of teeth among the Edentata. He quotes Max Weber to the effect, that the reduction of the teeth in *Manis* is so absolute; that not a single rudiment remains, and that there is, so to speak, no place left for the layer either of dentine or enamel. He then goes on to say: " After, in my earlier studies, I recognized the morphological importance of the dental fold, and finding it ended as a last rudiment of an earlier dentition both in the birds and turtles, I did not doubt that also in *Manis*, at least the first stages of a dental ridge must be present in the early embryonic development." With material received from Professor Max Weber himself, Dr. Röse demonstrates the beginnings of the dental fold both in the upper and lower jaws of Manis ; and in the lower jaw on both sides he finds even an unmistakable rudiment of the tooth layer, in the form of a swollen portion of the common dental fold, i. e. an abortive tooth cap. Such results were obtained in *Manis javanica.*

The forms investigated were the Nine-banded Armadillo (*Dasypus novemcinctus*), *Dasypus hybridus*, the Pangolin (*Manis javanica*), and the Anteater (*Myrmecophaga.*) In the Nine-banded Armadillo most careful researches were made upon the dental ridge in a series of 420 sections, leading to a discovery which was confirmed in the other species, that the dentition of the Edentata has arisen by degeneration from the dentition of a more highly organized mammàlian type. This result is directly contradictory to the hypothesis of Oldfield Thomas, that the Edentata were sharply marked off as *Paratheria* by the exceptionally simple features of their dentition among other characters.

Dr. Röse continues, that the enamel of the teeth has so far retrogressed, that only an upper capping of the enamel layer is formed, which lies directly upon the dentine. "In all cases in which we have instituted exact microscopical researches, in three species of Dasypus, and in Orycteropus, it is proved that invariably in the Edentata the typical two dentitions of the mammalia are exhibited in the embryonic stages. In every case as the tooth is constricted off, the dental ridge grows further backwards, as the basis of the successional tooth, as it has been observed in the development of the teeth in man and in the Opossum; and as Kükenthal observes, from a morphological standpoint it is of no moment whether this replacing ridge gives rise to teeth or not."

Dr. Röse anticipates that the Bradypodidæ will also prove to be diphyodont.

This author further shows that there are proofs of heterodonty which weigh against the opinions of Parker and Thomas, that the Edentata stand entirely aside from the other mammalia.

In the early stages of development, a continuous dental ridge is found in the whole jaw, and in the anterior part of the jaw two rudimentary teeth are observed which must be regarded as incisors. According to Rheinhardt, the number of rudimentary incisors in the Nine-banded Armadillo is still greater (four). The lateral tooth in Bradypus may be either an incisor or canine. Dr. Röse agrees with Tomes and Osborn that the canine should be considered as the most anterior premolar. Another question arises as to whether the posterior teeth of the Edentata are to be regarded as molars or as divided into molars and premolars. As Kükenthal has observed in the whalebone whale, we also find in young embryos of the Edentates a double pointed or biconodont tooth, which later divides secondarily into its single pointed components. The author considers it doubtful whether this biconodont type is primitive, or as seems to him more probable, is derived by degeneration from a triconodont type!

As regards the bearing of paleontology and comparative anatomy upon these facts, we find rudimentary incisors in the living *Dasypus setosus* and in the fossil *Chlamydotherium.* The latter shows the fusion of two conical points. The author refers also to Glyptodon, which has prismatic back teeth with a very evident triconodont type. He concludes by saying that these circumstances afford a very marked support for the opinion, that the present biconodont teeth of these Edentata, at least the posterior members of the series, have arisen by reduction of a typical triconodont type. If this is confirmed by further observation, it will be a fact of the very greatest importance in the phylogeny of the mammalia. For the triconodont type has been shown to prevail in the upper Triassic and lower Jurassic periods. There was unquestionably a vast period in the evolution of mammalia in which a triconodont molar was the only type.

SAUROPSIDA. In the conclusion of his work upon the development of the teeth in the crocodile, he reaches the following result: "The cause of the existence of the thecodont (fangless) teeth is to be found in the continuous growth of the epithelial sheath of Hertwig. . . . . . . The functional tooth of the crocodile is altogether analogous with a rooted mammalian tooth, the growth of which is not yet complete. The first embryonic tooth series of the crocodile, on the other hand, exhibits a development which we hitherto have only observed in the Selachia and Urodela through the labors of Hertwig. The theory of Hertwig as to the genesis of the mouth skeleton out of the cement sockets of tooth structure, has received an unexpected and weighty support by our researches."

The types examined by the author, included *Sterna Wilsonii,* the Ostrich, *Struthio camelus* and the turtle, *Chelone* *midas.* He anticipated from his studies upon the tooth development of the reptiles, that only traces of the dental fold would be found, and if any really rudimentary dentine teeth were found, they could only represent those primitive Selachian-like teeth which constitute the first series of the crocodile. In the crocodile as above noted, a first dental layer exhibits itself altogether similar to the placoid scales and the first teeth of the Selachians in the form of free papillæ upon the surface epithelium of the jaw.

TAEKER'S RESEARCHES.

Dr. Taeker of the Veterinary Institute of Dorpat, has completed a most interesting series of studies upon the embryonic form of the teeth in the Ungulates.

His technical methods were an improvement on those introduced by Klever, and his material included embryos of the horse as a type of the most complex form of perrissodactyl, of the pig as a modern bunodont, and of Selenodonts he selected the embryos of the Elk, Deer, Ox and Sheep, and of greater rarity, an embryo of one of the group of Tragulids. His conclusions are summed up as follows:

1. As a result of my investigations I find that both the Suidæ with rounded or bunodont cusps, and the Ruminants with their crescentic or selenodont cusps, arise from a similar initial bunodont stage; that is, all the highly complex forms of modern cusps spring from the simple ancestral hillock in the embryonic stages.

2. The order of differentiation soon follows, in which the separate cones and conids (cusps of the lower jaw) are transformed into pyramids in the case of the pig, and into crescents in the case of the ruminants.

3. The transformation of the cones is not effected simultaneously, but successively. In the upper teeth it does not begin with the protocone (antero-internal cusp which is first developed in the paleontological history), but with the external cusps, the paracone and metacone.

Order of Appearance of the Cusps. The author observes that while in the lower jaw the order and appearance of the cusps is the same in the embryo as in the paleontological history, in the upper jaw this ontogenesis is no longer parallel with phylogenesis, (as regards the upper teeth, this exception is confirmed by Röse). In fact the external cusps not only appear before the internal cusp, which paleontology shows to be more primitive but they assume the crescentic form earlier. In other words, their development is accelerated.

The development of the premolars is also traced and it is interesting to recall the fact that in the paleontological history, the order of evolution of the cusps of the premolars is not the same as that of the molars. Taeker's results therefore show a parallelism between Ontogenesis and Phylogenesis, in that he proves that the embryonic cusp order in the premolars is different from that in the molars, and is approximately similar to that in the ancestral history as recently worked out by Scott.

Upon the whole this parallelism between embryogenesis and palingenesis is most striking, and I think we can explain the exceptions which Taeker and Röse have shown to occur in the upper teeth both in the Primates and Ungulates, in the following manner: In the most primitive types of trituberculates, the protocone was the most prominent cusp in both jaws. This is seen in all the known Triassic and Jurassic trituberculates without exception. During the Cretaceous period a change took place, in which the upper molars rapidly diverged in pattern from the lower molars. The lower were more conservative, retaining the trigonid or triangle in its primitive proportions. The upper molars, on the other hand, must have undergone a marked change, consisting mainly in the depression of the protocone below or to the level of the paracone and metacone, as seen in the primitive Carnivores, Creodonts, and Insectivores of the Puerco period. Thus we find both in the Ungulates and sub-Ungulates or early Primates, that in the upper molars the outer two cusps are slightly more elevated and decidedly more progressive in the acquisition of new forms than the older internal protocone. For example the outer cusps often became crescentic, while the inner cusp remained rounded. And it was therefore during all the lower Eocene, that the external cusps surpassed the internal cusps in progressive development.

The bearing of these facts is this: in Embryogenesis, we are dealing with repetition of ancestral history; we should not expect, however, that this repetition would invariably extend back of the form characteristic of the Eocene period. As a matter of fact, the upper molars repeat their Eocene but not their Mesozoic form. The lower molars also repeat the Eocene form, and this, as explained above, owing to the conservative proportions of the cusps, is also the Mesozoic form, the protocone still being the most prominent cusp in the crown. While, perhaps, not thoroughly satisfactory, there is a great deal of probability that the discrepancy between the embryonic and phyletic order in the upper molars, is due to these differences in their phyletic history.

In the accompanying table I have summed up the phylogenetic order observed by Cope and myself, and the ontogenetic order observed by Röse and Taeker.

THE FUSION THEORY OF CUSP ORIGIN.

As we have seen, the fusion theory was first proposed by Kükenthal; it was afterward independently advanced by Röse. We find in addition to the grounds given above, one very strong argument against this theory derived from Paleontology, is in the law of molar evolution, namely, that the cusps appear at or near the apex of the crown, and development takes place from above downward. Thus, so far as we can judge from *Dromotherium* and *Microconodon*, the lateral cusps first appear on the sides of the protocone, and much later, the fang subdivides; the lateral cusps are at the outset very much smaller than the medium cusp, and it is only after a long course of evolution that they attain the same size.

Now, if the fusion theory were correct, and the triconodont crown, for example, were constituted by the fusion of three

Table showing the Phylogenetic Order as observed by Cope and Osborn, and the Ontogenetic Order as observed by Röse and Taeker.

A. Phylogenetic Order.				B. Ontogenetic Order.			
Geological Periods	Order.	Cusps	Comparative—Human.)	Primates 2)	Marsupials 2)	Ungulates 3)	Order.
		Upper molars.					
Permian	1	Protocone	Ant. lingual.	Paracone	Paracone	Paracone	1
Triassic & Jurassic	2 & 3	Paracone	" lateral.	Protocone	Proto- "	Meta- "	2
		Metacone	Post "	Metacone	Meta- "	Proto- "	3
Cretaceous	—						
Eocene & Miocene	4	Hypocone	Post. lingual.	Hypocone	Hypo- "	Hypo- "	4
		Lower molars.					
Permian	1	Protoconid	Ant. lateral.	Protoconid	Protoconid	Protoconid	1
Triassic & Jurassic	2 & 3	Paraconid	(degenerated 1))	Metaconid	Para- "	Meta- "	2
		Metaconid	Ant. lingual	Hypoconid	Hypo- "	Hypo- "	3
Jurassic	4	Hypoconid	Post. lateral	Entoconid	Ento- "	Ento- "	4
Cretaceous	5	Entoconid	" lingual	Hypoconulid	Meta- "		5
Lower Eocene	6	Hypoconulid	" mesial				

---

1) This cusp degenerates both in the early Primates and Ungulates.
2) As I understand Dr. Röse.
3) As I understand Dr. Taeker.

distinct cones, these cones should certainly appear sub-equal from the first, and they should present a division extending to the base and indicated in the fang. From the fact that Kükenthal does not mention the above genera, we infer that his attention has not been called to them. In one of his latest addresses he speaks as if the multituberculates were the only Triassic mammals. We know that the trituberculates were as old or older than the multituberculates, and reasoning by analogy, I have attempted to show elsewhere that the multituberculates will be found to have a trituberculate origin.

As I have lately criticised this theory in some detail in the "Anatomischer Anzeiger," I here refer to the well-known evidence which renders the Kükenthal-Röse hypothesis both superfluous and untenable; when we find in the series such as is represented by the genera Dromotherium, Microconodon, Spalacotherium, Amphitherium, Miacis, exhibiting in the lower jaw all the stages between the sectorial and bunodont crown, and when in the early Ungulates we are able to trace one by one the successive additions of cusps to the bunodont molar, often in the center of the crown, it certainly is not necessary to attempt to establish any new hypothesis as to cusp origin.

SUMMARY OF RESULTS.

The general bearing of these researches upon the stem forms of the pro-mammalia is extremely important. To summarize, it is rendered probable that the earliest forms of mammals were homodont and had two or more series of successional teeth. Then within the mammalian stem the teeth were differentiated, and there arose a great heterodont group with teeth at least of three kinds—incisors, premolars and molars, all successional. From the most anterior premolar arose the canine. Then came the division between the Marsupials and the Placentals, the former tending to suppress the development of the second series of teeth, the latter retaining the second series as far back as the first molar.

We can see an obvious advantage in the line of succession being drawn at the first molar,[1] for upon the molars rested the necessity of complex development, and such development was best effected in permanent crowns.

1. All the so-called "milk molars" plus the so-called "true molars" constitute the *first series*. Beneath one or more of the "true molars" in lower mammals are rudiments of a second series. The *second series* consists therefore of these sub-molar rudiments plus the successional or permanent premolars, incisors and canines.

2. In the stem Marsupials the entire first series persisted and became mainly permanent (non-deciduous); the second series became rudimentary and non-successional with the exception of the fourth upper and lower premolars and possibly one or two other teeth which either replaced or were intercalated between members of the first series. One or more premolars were suppressed and one more molar retained than typical in the Placentals. Thus is explained the apparently atypical dental formula of Marsupials.

3. In the stem heterodont Placentals (excepting the Cetacea and Edentata) the entire first series persisted and all the incisors, canines and premolars remained deciduous. The successional second series persisted as far back as the first molar.

4. In the stem Cetacea the entire first series persisted and the second series became rudimentary and non-successional. The tooth form changed from a heterodont to a homodont type.

5. In the stem Edentates, which also transformed from the heterodont to the homodont type, the first series became rudimentary and the second series persisted in the succession even behind the region of the first molar.

Finally, there is evidence that a primitive succession in the region of the molar teeth, lost in the Marsupials and in the Placentals, was more or less fully retained in the Cetacea and Edentates.

---

[1] The law of molar evolution is that complication is most rapid in teeth which are longest in use. Thus the first molar is the most progressive tooth of the true molar series and the last premolar is the most progressive of the premolar series. The apparent exception that the third milk premolar is always an advance type of the third permanent premolar is explained by the fact that the milk premolars are formed to assume the molar function.

Biological Department, Columbia College, April 10, 1893.

BIBLIOGRAPHY.

Kükenthal. "Das Gebiss von Didelphys," Anatomischer Anzeiger, 1891, Nr. 23, 24.

"Einige Bemerkungen über die Säugethierbezahnung" Anat. Anzeiger, 1891, Nr. 13.

"Uber den Ursprung und die Entwickelung der Säugetierzähne," Jena, 1892.

"Ueber die Enstehung und Entwickelung des Säugetierstammes," July 15, 1892, Biologisches Centralblatt.

Röse. "Uber die Entstehung und Formabänderungen der Menschlichen Molaren." Anat. Anz., 1892, Nr. 13, 14.

"Ueber die Zahnentwickelung der Krokodile" Verh. d. Anat. Gesellschaft, June, 1892.

"Beiträge zur Zahnentwickelung der Edentaten" Anat. Anz., 1892, Nr. 16, 17.

"Ueber die Zahnentwickelung der Beutel tiere" Anat. Anz., 1892, Nr. 19, 20.

"Ueber rudimentäre Zahnanlagen der Gattung Manis." Anat. Anz., Nr. 19, 20.

"Ueber die Zahnleiste und die Eischwiele der Sauropsiden." Anat. Anz., 1892, Nr. 23, 24

"Zur Phylogenie des Säugetiergebisses." Biol. Centralb. Nov., 1892.

Taeker. "Zur Kenntniss der Odontogenese bei Ungulaten." Inaug. dissert, Dorpat, 1892.

SYMBIOSIS AND MUTUALISM.[1]

By Roscoe Pound.

Symbiosis and mutualism, in the vegetable kingdom at least, are phenomena accompanying parasitism. Parasites have various effects upon their hosts, according to the nature of the parasite, its mode of life and method of attack. In some cases the host is quickly killed and the parasite becomes a sort of saprophyte upon the remains. In others the host lives longer or is only partially affected. In still others the host lives on side by side with the parasite indefinitely. A further development is attained in cases where the parasite and host not only live together, but are mutually beneficial, and, perhaps, even, in extreme cases, inter-dependent. To the first phenomenon —namely, the living together of parasite and host—DeBary, in 1869, in a work entitled *Die Erscheinung der Symbiose,* gave the name of Symbiosis. The latter phenomenon—i. e., mutual assistance or inter-dependence of parasite and host—was named mutualism in 1873 by Van Beneden in his "Animal Parasites and Messmates." Symbiosis in the strict sense and mutualism are often confounded, that is, the term symbiosis is often used to mean mutualism as such; but, in strictness, while mutualism, in the case of plants, can only exist with symbiosis, in the larger proportion of cases of symbiosis there is no mutualism.

At the outset it should be noted that the mutualism of which we are here speaking is mutualism of parasite and host—not mutualism of independent organisms. Of the latter, we have many examples in the animal kingdom, and, indeed, the human race furnishes examples of it. There is a sort of mutualism between man and wheat, for example. Wheat is cultivated by man and enabled to grow in quantities, and in localities which, under ordinary conditions, would be impossible. It gains this partial exemption from the struggle for existence only at the expense of an immense number of individuals sacrificed, but it is, nevertheless, a great advantage which it gains. This may be called mutualism. But there is a case of mutualism of plant and animal much more closely resembling the mutualism of parasite and host in the vegetable world. The mutual inter-dependence of *Yucca* and a moth of the genus *Pronuba*, is probably the most unique and interesting case of mutualism to be found anywhere. This is well described by Mr. Webber in the AMERICAN NATURALIST for September, 1892. In this case the plant and the moth, if not strictly sustaining the relation of parasite and host, live together for a long period, and it approaches much closer to mutualism as found between vegetable organisms than phenomena like entomophily where animals and plants are mutually beneficial, without any approach to symbiosis. In the vegetable kingdom, mutualism is a relation of mutual benefit between organisms living together as parasite and host.[2]

---

[1] Read before the Botanical Seminar of the University of Nebraska, December 17, 1892.

The most conspicuous and earliest observed instance of mutualism in the vegetable kingdom is the relation of the Lichen fungi to their gonidia or algal hosts. The relation of the lichen thallus to its contained gonidia was, at one time, the subject of no little ridicule, not only because its discovery overturned many established ideas, but because it really did seem at variance with common sense. A parasite of far larger size than its host, controlling the growth of its host—not growing within or upon the host, and following its growth at a distance, but growing outside of the host, spreading in all directions of its own motion, and being followed by the slower growth of the host—such a parasite was indeed a novel phenomenon. We cannot blame the lichenologists of the old school for their facetious remarks about the horse parasitic upon the bot and the symbiotic relations of Jonah and the whale.

If all lichens were the large, robust parasites that the commoner lichens are, we should have reason to hesitate long before accepting so remarkable a phenomenon as established.

---

[2] The case of the bacteria in the "pitchers" of *Nepenthes* and other carnivorous plants seems, according to the investigations of Tischutkin, to been exception. See AMERICAN NATURALIST, May 1893.

Fortunately, the lichens exhibit several intermediate forms, and enable us to see the relation between the phenomenon found in the commoner lichens and ordinary parasitism.

Lichenologists have, for a long time, distinguished, under one name or another, two classes of lichens. In the one group the thallus is entirely or substantially homogeneous—there is no differentiation into rind, medulla, etc. In the other there there is a well-defined rind, and gonidial and other zones are differentiated. The former have been called homœomerous lichens, the latter heteromerous lichens. In the first group the alga is the principal part of the lichen. The hyphæ grow within the mass of algal cells and follow them in their growth. To this class belong *Collema* and like genera, which are fungi parasitic upon *Nostoc*, *Scytonema*, etc., and growing within the gelatinous membranes and sheaths enveloping those algæ. Here there is symbiosis—a living together of parasite and host—but no one will contend that there is mutualism.

In the second group the fungus is the principal part of the lichen. It contains in its thallus a zone of algæ, but they follow the growth of the thallus, and their bulk is a small proportion of the whole lichen. In these lichens the algæ are *Protococcoideæ* or *Palmellaceæ*, etc., and to the different mode of growth of these algæ the difference is largely to be attributed.

Between these groups there are a number of forms, usually classed as heteromerous lichens, which, nevertheless, show no differentiation of medulla and rind, and in which the thallus consists of a weft of slender hyphæ growing around filaments of *Chroolepus* and like forms. Still another fact is important in this connection. Some of the genera of this intermediate group have species which contain no gonidia and are saprophytes upon bark, and indeed the parasitic species are often saprophytes during a part of their existence. Many genera of fungi exhibit the same phenomenon.

It is seen, then, that mutualism does not exist in all lichens, and that the steps from an ordinary case of parasitism, such as that exhibited by the homœomerous lichens, which consist of a mass of algal cells permeated by the hyphæ of a fungus and often distorted by it, to the peculiar case of the heteromerous lichens, where the fungus forms an extensive thallus in a zone of which are contained the algæ upon which it subsists, may be traced in existing species. Not only this, but there are genera, as has been said, in which there are species that do not attack algæ, but live independently as saprophytes, and the point to be noticed here is that these genera belong to the intermediate group of what I may call pseudo-heteromerous lichens.

These considerations, of course, do not prove the existence of mutualism in lichens, but they deprive it of much of its seeming unreasonableness. Other facts, now well established, make it certain that this relation really does exist in the heteromerous lichens.

Arthonia is one of the pseudo-heteromerous lichens. Moreover, it is one of those genera in which certain species, during their entire existence, live independently as saprophytes. Of its development, De Bary says: " . . . . the hyphæ of the thallus make their way into the outer layers of the periderm in the smooth stems of oaks and ashes and there grow as saprophytes independently, that is, without algæ, into a thallus formed of an abundance of slender hyphæ which spread through the cells of the periderm. Then its proper alga, *Chroolepus umbrinum,* finds its way from without through the cell walls of the peridermis into the previously formed hyphal thallus and is seized by it. The cells of the *Chroolepus* are in rows forming filaments with apical growth, and it is by means of this growth that they penetrate into the thallus in the same way as mycelial hyphæ pierce through membranes. The alga is a frequent inhabitant of the bark of trees, and makes its way into the periderm for its own purposes. Its penetration into the thallus of the fungus can scarcely be supposed to be caused by the fungus, but is merely an adaptation which favors the formation of a lichen." This is plainly an ordinary case of parasitism on the part of the lichen, but it not only throws light on the origin of the true heteromerous lichens, but it shows in what manner the fungus may be of benefit to the algæ. In the heteromerous lichen the thallus takes the place of the bark of the tree in these pseudo-heteromerous lichens.

gonidia of the heteromerous lichens are usually *Palmel-* , which, from their different structure and mode of growth, not the power of getting beneath the bark as does *Chroo-* . The thallus of the lichen serves the same purpose them—protecting the colony of algæ and absorbing retaining unusual quantities of moisture, and enabling to live and multiply in places where, under ordinary itions, life would be impossible.

at the thallus does do this is shown by the fact that ns grow in places where algæ could not maintain them- s unaided, and by the fact that the gonidia multiply with rapidity in the thallus, often more so we are told than out, and the individual cells attain a larger growth within hallus than without, as has been shown by taking algae the thallus and cultivating them independently. That ungus does not do all this for nothing, the numerous usted cells to be found in the gonidial zone of any ordin- ichen abundantly testify.

ere is another curious phenomenon exhibited in some ns. In these species the algæ are not confined to the dial zone, but grow up into the tissues of the sporocarps een the paraphyses and among the asci, so that when the pores are ejected, cells of the algæ are ejected with them are promptly seized upon by the germinating spores. This hardly be accidental, and it should be observed that it is lga which is the moving party, not the fungus. Surely benefit must result to the alga or it would not be done.

is possible, also, that there are other adaptations resulting the symbiosis of fungus and alga in the lichen. Frank ns to have discovered several, one of which deserves men- It is well known that algæ can be separated from the n, and that they will then vegetate in the ordinary way pendently. Frank asserts that certain species of algæ become so adapted to life in the lichen and so accustomed that they have partially or wholly lost the power of inde- ent growth. No examples of this, however, are certainly n.

Frank also claims that the fungus exhausts the protoplasm of algal cells without entirely destroying them. If by this is meant that it does not always entirely destroy the cells it attacks, it is probably so, but if anything more is meant, it seems, like some other theories of Frank, which I shall have occasion to mention presently, if I may say so, decidedly "fishy." Such a thing is not necessary to mutualism. The alga can purchase the protection of the thallus only by the sacrifice of a large number of individual cells. If it gets *quid pro quo*, why should it not prefer to sacrifice them to the fungus in return for the shelter of the thallus rather than to leave them victims to natural conditions without compensating advantage. To put the matter in another way, if the energy spent by the alga in producing cells to be destroyed by the fungus were put to making a shelter of its own, could it effect as much as it does by taking advantage of the thallus?

Two other cases in the vegetable kingdom where mutualism is thought to exist remain to be examined. These are the cases of "*Pilzsymbiosis*" or "*Wurzelsymbiosis*" of the roots of anthophytes and certain fungi. The first noticed was what is termed "*Mycorhiza*," and of this first.

T. Hartig, in 1840, and others since, had noticed mycelia apparently parasitic on the roots of trees. In 1885, Frank published the results of investigations of mycelia growing upon the roots of various *Cupuliferæ* in which he claimed that the sustenance of these trees depends upon fungi symbiotic with their roots. The title of his paper indicates his claim: "*Ueber die auf Wurzelsymbiose beruhende Ernaehrung gewisser Baeume durch unterirdische Pilze.*" To begin with, Frank found that certain *Cupuliferæ* have almost the whole of their root system covered with mycelium associated symbiotically with the root, and he claimed that these fungi took the place of root hairs, and were the only means of absorbing water, etc., possessed by the roots, though, of course, like the gonidia of lichens, the roots could be grown independently in water cultures for years.

The mycelia, of the existence of which there is no doubt, are probably connected with some of the *Gasteromycetes* or *Tuberaceæ*. But Frank observes that the presence of a mycelium does not necessarily imply the presence of the perfect fungus fructification, as mycelia may, and often do, go on growing in a sterile condition for years.

Frank did not stop here. He found symbiotic fungi on the roots of many other trees, and others after him found mycelia on the roots of various plants to which he attributes the same relations of mutualism. His final statement is that this phenomenon belongs " to all trees under certain conditions ; " that " the Mycorhiza is formed only in a soil which contains humous constituents or undecomposed vegetable remains ; " that " the development of Mycorhiza increases or diminishes with the poverty or richness in these constituents ; " and that " the fungus of the Mycorhiza conveys to the tree, not only the necessary water and the mineral nutritive substances of the soil, but also organic matters taken direct from the humous and decomposing vegetable remains." Finally, he claims that only through the fungus can the tree employ such organic matter directly.

If the fungus develops only in soil containing undecomposed vegetable remains, we might ask why it takes the trouble to attach itself symbiotically to the root and give the tree the benefit of its saprophytism; especially, as Frank says that the protoplasm of the cells and the fungus live together " without the former being parasitically affected or its vital phenomena disturbed." This reminds one of the exhausted gonidial cells which are still uninjured, and is not the only one of Frank's statements calculated to try our patience and credulity.

In 1886, Warlich (*Botanische Zeitung*, 1886, p. 481, et seq.) investigated certain fungi on the roots of orchids. He examined several hundred species, all of which he found affected on both aerial and subterranean roots with the mycelia of what he showed to be a species of *Nectria*. The hyphæ of this fungus affect spots here and there, forming knots or coils in certain cells and causing them to enlarge, but, as a rule, only partly filling the cell and not destroying the protoplasm. Frank, of course, took this up, and he claims that the protoplasm of the cell is not affected or disturbed by the fungus; that the fungus is strictly connected with that part of the plant which absorbs the food materials; and that those orchids which are chlorophyll-less, and therefore depend on the humus of the soil for carbonaceous matter, always exhibit this fungus highly developed. Accordingly, he includes this too in Mycorhiza, calling it "endotropic Mycorhiza" (i. e. the hyphæ live *in* the cells) as opposed to "ectotropic Mycorhiza" in which the fungus is entirely *outside* of the cells.

As to Frank's statement that the protoplasm of the cell is not affected by endotropic Mycorhiza, Marshall Ward, in the *Annals of Botany* for February, 1888, says: "This can only be an assumption, and the impression I gather from the study of what is known of this orchid fungus is in favor of the view that the fungus *does* disturb or 'parasitically affect' the protoplasm of the cell, and that an outward and visible sign of some such action exists in the hypertrophy of the cells affected and in the turning yellow of the chlorophyll-grains."

R. Hartig, a more sober and trustworthy writer than Frank, said the last word so far on Mycorhiza in 1891. He admits that the mycelia of some of the *Tuberaceæ* or *Gasteromycetes* are found symbiotic with the roots of certain trees. But his conclusion is that they are of no use to the tree, and are probably injurious by taking nourishment properly belonging to the tree. It would seem that they must do this, even were there mutualism between them and the roots—else why are they there? Organisms are not given to gratuitously assisting one another. Mycorhiza undoubtedly exists—i. e., mycelial stages of many fungi of different groups are parasitic upon and in the roots of anthophytes. But that there is, in any of these cases, more than the ordinary symbiosis of parasite and host, has not been shown, and is improbable. That every tree has its root system covered with mycelia, proves nothing. Every tree has its bark covered with lichens, its twigs with black fungi, and its leaves with parasitic fungi of every description.

The second case of "*Wurzelsymbiosis*" is the root tubercles of the *Leguminosæ*. These tubercles have long been known upon clover, and of late years—since 1885, in fact—have been found upon nearly all of the *Leguminosæ*. Naegeli found a *tridium*-like parasite in the cells of *Iris* which has never 1 seen since, and named it *Schinzia*. So when, in 1879, nk first worked upon clover tubercle, he considered it sim- to Naegeli's *Schinzia*, and named it *Schinzia leguminosarum*. sequently, a tubercle was found on the roots of *Alnus* by ronin, called by him *Schinzia alni*. Tubercles have been id in this country on the roots of *Ceanothus*, and are known 1 few other plants besides the *Leguminosæ*.

here has been considerable uncertainty as to the cause of er tubercle and the nature of the parasite to which it is . Schroeter took the parasite for a Myxomycete similar to *smodiophora* and named it *Phytomyxa*. Marshall Ward, in article cited, compares it to the yeast fungi. De Bary, in 4, dismissed the matter with a sneer. Frank now puts the asite among the *Schizomycetes*, and, indeed, the best view ns to be that the parasites are bacteria pure and simple. re are, in some tubercles, hyphæ, or something very like hæ, which Frank now calls "*Infektionsfaden*." Marshall rd considered these the hyphæ of which what some call the *ktroiden*"—i. e., the bacteria—were spores. Schroeter saw hem a plasmodium. Frank, always unique and startling, finally (1891) decided that the "*Infektionsfaden*" have ning to do with the fungus, but are products of the host for purpose of self infection! These hyphæ are usually filled 1 the "*baktroiden*," and Thaxter's recent discovery of *Myxo-eria* may throw some light upon their true nature. In an cle in the *Torrey Bulletin* for July, 1892, Mr. Schneider cludes that these tubes have nothing to do with the bac- a, or *Rhizobia*, as Frank now calls them, and considers them hal fungi related to the parasite of *Alnus* tubercle. As e tubes often contain the bacteria, this seems improbable. m all that I have read and seen, I am satisfied that the asites are bacteria, and I see no reason for separating them n the rest of the *Schizomycetes* as Schneider does. I even bt the necessity of creating a separate genus for them, as nk did in 1890, under the name of "*Rhizobium*" (*Pilzsym-e der Leguminosen*).

These tubercles are fine examples of symbiosis, and it has recently appeared probable that they exhibit mutualism of an unexpected kind, analogous to that claimed by Frank for his Mycorhiza. I can only go into this briefly. It is known that the plant cannot directly assimilate free nitrogen. Yet, as Marshall Ward puts it, "For a long time it has been generally known that the *Leguminosæ*, especially, have what we may term a special aptitude for seizing large quantities of nitrogenous substances from the soil, and this problem has become a classical puzzle in vegetable physiology." In 1886, Hellriegel and Wilfarth published some investigations of this matter. Subsequent experiments founded on theirs have been very numerous, and are yet in progress, but their researches remain our principal authority on the subject. Without detailing them, I may say that these researches seem to demonstrate that this power of taking up large quantities of nitrogen depends entirely upon the presence or absence of the tubercles —that without them it does not exist, and that it exists in greater or less degree according to their abundance. Conceding this, two theories are possible as to the cause.

In 1888, Marshall Ward appeared to think that the parasite stimulated the cells to extraordinary metabolic activity, and that was probably all it did. This view has had no followers so far as I can find.

The other possible theory is that the parasite does this work and the host takes advantage of it. Frank, as might be expected, takes this view. The most recent observations seem to have settled pretty thoroughly that the tubercles do assist the plant in some way in assimilating free nitrogen, and that here is a case of mutualism analogous to that of the lichens. The bacteria (as I assume that they are) are parasites. They are there for their own purposes, and are incidentally beneficial to the plant. The plant, it is generally admitted, can exist and thrive without them. In some cases it appears, and the analogy of the lichens makes this probable, that the bacteria are purely parasitic, and that there is symbiosis without mutualism. But, in most cases of the *Leguminosæ*, it seems to be shown that the plants affected do better than those unaf-

d. Much research is needed in this matter. The manner hich the parasite acts and the host takes advantage of its are not known with any certainty.

these probabilities, Frank adds certain characteristic robabilities. One has already been spoken of, namely, the plant develops tubes or hyphæ for the purpose of self-tion which it sends through its tissues. This is somewhat the algæ in some lichens which grow up among the asci he sporocarp and are ejected with the spores. Only the r is an established fact, the former a feat of the imagina- Another of his ideas, pronounced a "settled fact" by eider in the article cited, is that "at the close of vegeta- and on other special occasions, the plant reabsorbs the plasm of the fungi." After all the trouble of self-infec- to which the host has been, this seems rather like killing hen that laid the golden egg. There is no sufficient evi-e to establish so remarkable a phenomenon. Finally, k thinks that the roots of the *Leguminosæ* possess the er of attracting *Rhizobia*, due, as he considers, to some tion. This is too much for his followers, and I think all agree that it is the last straw of an unsupportable load which he has already burdened our credulity. The erance of Frank's enthusiasm, however, should not blind the fact that some relation of mutualism between the *minosæ* and the tubercle parasites probably—almost cer-y—does exist.

is not necessary, as Frank seems to think, in order to lish mutualism to show that the organisms do no injury ach other. Mutualism of the kind we meet with in the table kingdom involves sacrifices on the part of the host. parasite is not there gratuitously. It is there to steal from ost the living it is hereditarily and constitutionally indis-d to make for itself. If the host gains any advantage from elation, it can only do so by sacrificing—by giving the para-the benefit of its labor that it may subsist. If the plant or lant colony benefits as a whole, it purchases the benefit by sacrifice of certain parts or individuals. Mr. Webber, in a on the Yucca moth in the AMERICAN NATURALIST for September, 1892, makes a significant remark to the same effect: "The larva of *Pronuba* uses up only from 10 to 12 seeds, so that even in those capsules where the most abundant larvæ develop, hundreds of good seeds are nevertheless developed. The few seeds destroyed may well be sacrificed to insure the pollination and development of the others."

Ethically, there is nothing in the phenomena of symbiosis to justify the sentimentalism they have excited in certain writers. Practically, in some instances, symbiosis seems to result in mutual advantage. In all cases it results advantageously to one of the parties, and we can never be sure that the other would not have been nearly as well off, if left to itself.

EVOLUTION AND DICHROMATISM IN THE GENUS MEGASCOPS.

BY E. M. HASBROUCK.

INTRODUCTION.

The subject of Dichromatism has ever been a stumbling-block to scientific research, and from the time of its earliest admittance into zoological discussion, has been without apparent cause and without explanation. Few, if any, theories have been published as to what it really is, or as to the possible influence governing it, while any theories that have been advanced stand without proof of their correctness; a new theory, therefore, cannot be considered as conflicting with any *settled* doctrine upon the subject. When we find a peculiarity common to all forms of animal life, it becomes apparent that if thoroughly understood in one form, a flood of light will be thrown upon the same perplexing problem affecting the rest of the animal kingdom.

In attempting to explain the causes and effects of dichromatism in the Screech Owl, no stone has been left unturned to prove the correctness of the views herein set forth. The writer has labored lovingly and patiently, following a course of reasoning which he believes to be correct, and in submitting his work and its results to fellow-workers would ask for it their kindly consideration. The collection of the necessary data has been an extremely difficult task, and more information is still desirable from certain localities, although sufficient has been received to make possible the construction of a comparatively accurate map of the color distribution. It is a lamentable fact that scientific observers of bird life are exceedingly scarce in the southern states and in the lower part of the Mississippi Valley. The data obtained from these regions, although to a certain extent more scanty than could be desired, has been used to the best possible advantage. In obtaining information, copies of the following circular letter were sent out by the National Museum, and the matter received in reply was turned over to me for study and investigation, together with the privilege of preparing the results for publication.

UNITED STATES NATIONAL MUSEUM
UNDER DIRECTION OF
THE SMITHSONIAN INSTITUTION.

Dear Sir:

The National Museum is engaged in a systematic investigation of the color-phases of the Screech Owl (*Megascops asio*), with the view of determining the relative abundance of the red and gray plumages in different parts of the country, the plumage of the young, produced by parents of known character as to plumage, and the other related questions.

In order that the investigation may be as thorough as possible, assistance in the matter is requested; and if you can give information on the subject, your kind co-operation will be much appreciated.

Should you favor us with any information on the subject, please arrange the data in the following order:

(1) Name your locality, including County and State.

(2) State about how many specimens have come under your notice, and how many of them were in the gray plumage.

(3) If you have obtained or observed a pair of old birds with their young, state the character of plumage of the former (whether both red, both gray, or one red and one gray—and if the latter, the sex represented by each phase), and also the plumage of the young.

The above are the principal points upon which information is desired, but any additional memoranda will be very acceptable.

Yours truly,
ROBERT RIDGWAY,
Curator, Department of Birds.

In conclusion I wish to express my gratitude to Professor G. Brown Goode, Assist. Secretary of the Smithsonian, and Mr. Robert Ridgway, Curator of Birds, who rendered every assistance and courtesy in their power; while to all who responded to the request for information, without which the task would have been impossible, is due the sincere thanks of The Author

PART I.

RELATIONSHIP OF DICHROMATISM TO EVOLUTION.

So universally adopted has the theory of evolution become, that it scarcely seems necessary to refer to it as forming the foundation of the theory here advanced, regarding the dichromatic phases of the common Screech Owl (*Megascops asio*).

"In the Systema Naturæ (Vol. I, 12 Ed., 1766, p. 132), the Red Owl is first described by Linnæus under the name of *Strix asio*. Twenty-two years later (1788) Gmelin described (Systema Naturæ, Vol. I, 13 Ed., p. 289) the Mottled Owl as *Strix nævia*. In 1812, in the fifth volume of his American Ornithology, Alexander Wilson re-describes the two under the same names, also as distinct species, and not until 1828 does it appear to have been publicly hinted that the two were really identical, when Prince C. L. Bonaparte united them, he considering the red bird as the young, and the gray the old. Audubon, in 1832, sustains this view; one of the red birds he figures as the young, being one he reared from a fledgling. Nuttall, a few years later, supports the same view. In 1837, Dr. S. Cabot, Jr. (Journ. Bost. Soc. Nat. Hist., Vol. II, p. 126), while considering the two birds identical in species, reverses the order, making the red plumage the old and the gray the young, and in confirmation of his views exhibited as seeming conclusive evidence, an old red bird which he shot while in the act of feeding some gray young, which he also exhibited. In July of the same year, Dr. Ezra Michener, in a paper (Phila. Acad. Nat. Sci., Vol. 7, p. 53) entitled, *A few Facts, in Relation to the Identity of the Red and Mottled Owl*, states that he had seen young Screech Owls, accompanied by their parents, after leaving the nest, of both red and gray colors, the parents being always of the same color as the young. "The conclusion is, therefore," he says, "evident, either that the color of both old and young is variable or uncertain, or that they are specifically distinct." The latter opinion he adopts, ignoring the then sole known case of different colors in the young and parent exhibited by Dr. Cabot, very positively concluding that there are *two* species, and that Wilson was right.

Dr. P. R. Hoy, in his *Notes on the Birds of Wisconsin* (Proc. Phil. Acad. Nat. Sci., 1853, Vol. 6), gives them as two distinct species, while Cassin, in his various papers on the owls, adopts the conclusion of Bonaparte; considering them as one species, and the gray the adult."[1]

---

[1] Am. Nat., II, 1866, 327–328.

Again, Dr. W. Wood (Am. Nat., Vol. II, 1868, p. 371), mentions two cases:—the one, a Mottled Owl, taken from the nest with one young, neither of which had a red mark on them; the other, a Red Owl, taken with four young, all red. His deductions are, that there are two adults, one red without a gray feather, the other gray without the slightest trace of red; also, that there are young of each before they are able to fly, one gray and white without a red feather, the other with a reddish tinge to all the feathers. These facts he is unable to reconcile, unless, as he says, "It is admitted that the color of the plumage is either 'vaiiable or uncertain,' or else there are two distinct species as described by Wilson."

The whole is admirably summarized and described in Baird, Brewer and Ridgway (Vol. III, 1874, p. 51), in the following words, "That these two very different plumages are entirely independent of age, sex or season, and that they are purely individual there can be no doubt, since in one nest there may often be found both red and gray young ones, while their parents may be either both red or both gray, the male red and the female gray, or *vice versa.* Occasionally specimens are exactly intermediate between these two plumages, it being difficult to decide which predominates."

This difference in plumage has been termed Dichromatism, and while a hundred and twenty-five years have succeeded in establishing the fact that the red and gray screech owls are one and the same species, no satisfactory theory known to the writer has been advanced as to what dichromatism is due in this case or as to the possible causes governing it.

Naturally enough, this is far from satisfactory, while the opinions of various authors just quoted, and which comprise the most of what has been written upon the subject, tend but to raise innumerable queries for which there appear to be no satisfactory answers. Why, for instance, is the gray form dominant in one part of the country and the red in another? Why are both forms equally common in a third? Why is the red phase peculiar to the eastern members of the genus, while in the western forms it is unknown? Above all, why, at the northern boundary of *asio* proper, is the red form entirely absent, while at the southern limit it is greatly in the majority? These and many other questions of equal importance present themselves, and but confuse and leave the reader more than ever in the dark.

While collecting screech owls in the District of Columbia during the winter of 1890–91, these questions arose very forcibly, and upon investigating, I found that while the matter was apparently settled to the satisfaction of ornithologists, as regards the identity of the two forms, nothing further appeared to be known about it. Further investigation showed that dichromatism is principally confined to the typical form of *Megascops asio*, appearing but slightly in the Florida form (*Megascops a. floridanus*), and barely reaching the Texan subspecies, *mccallii.* The remaining members of the group, four in number,[1] remaining true to their normal color.[2]

Three phases of plumage were clearly defined—the red, the gray, and the intermediate (the last less frequently seen than the others). Three distinct phases, represented indiscriminately by individuals of one species, regardless of age, sex or season! Such an unusual circumstance that the possibility of some great and important change gradually taking place at once suggested itself, which has been proved to be in reality the case.

An attempt will be made to show, first, that while the red, the gray and the intermediate phases are at present but individual variations of the same species—the gray was the ancestral stock; second, that from the gray bird has evolved the red, which at some future time will be a recognized sub-species with a range peculiar to itself, and thus dichromatism is one step in the evolution of the Screech Owl, while the various phases exhibited are the transitorial stages of development of one species from another; third, that this condition of affairs is influenced by four powerful factors (two of which temperature and humidity, are dominant powers in geographic distribution), the most potent of which is temperature; fourth, that the *predominating* distribution of the respective colors is largely confined to the faunal divisions of the Eastern United States, and as such is approaching the sub-specific differentiation of the two phases; lastly, that the Darwinian theory of 'Reproduction with variation and the survival of the fittest,' is well exemplified in our common little *Megascops asio*.

---

[1] Three sub-species recently described by Brewster (Auk, Vol. VIII, 1891, 139–144) would make the number seven, but these are not as yet admitted to the check list.

[2] *M. a. kennicottii* exhibits a dichromatic phase, but it is a decided dark brown, and not a reddish phase, and is not included in the present treatise.

The Screech Owl has been made the subject of investigation simply because it offers one of the best known examples of dichromatism: if explained and disposed of in one case, much light will be thrown upon the same problem relating to many forms of animal life.

To begin with, a short description of the young, together with the manner of attaining the adult plumage of both phases, may be of service to many not thoroughly acquainted with the species. When first hatched they are covered with pure white down, which in a week or ten days begins to show faint traces of transverse dusky bars. At the age of four weeks they are fully barred with gray and white alternately, which markings they retain until the appearance of the first full plumage. As a usual thing, those destined to be red assume a rufous cast in the down shortly before the appearance of the feathers, but this is not always the case, as instances are known where the first intimation of red was the appearance of a rufous feather pushing its way through the gray or mottled down. Such instances, however, are rare, and but few are known to the writer. At the period when feathers first appear, the future color of the young bird is settled beyond a doubt; both the gray and the red birds rapidly attain their mantle, and the colors once assumed are never changed. Much confusion has arisen from the fact that some observers apparently make no distinction between the bird in the gray or mottled down and the gray or mottled plumage and upon the appearance of the red feathers through the gray down, the assertion has been made that the gray feathers changed to red. The gray birds, on the other hand, attain their plumage at precisely the same time and in the same manner as the reds, only that their feathers are gray instead of rufous. If the above simple facts are borne in mind, no trouble need be experienced in undertanding the appearance of the two plumages.

The first step in the work was to ascertain the relative proportion of the red and gray phase in every section of the area covered by the *asio* group of *Megascops* affected by dichromatism. For this purpose nearly one thousand copies of the circular letter referred to in the introduction, were sent to the ornithologists distributed over this territory. Over two hundred replies were received, a few of which failed to be sufficiently explicit to make their contents available, but enough were obtained to compile in a reasonably accurate manner the map showing the distribution of the two color phases (map 2).

On the northern border of the range of *Megascops asio* where gray is the only form known (see map 2), correspondents from southern Ontario state that at occasional rare intervals a red specimen has been taken *in the spring*; all these birds were taken close to Lakes Erie and Ontario—while at Toronto, one pair composed of a gray and red have been known to breed, which necessitates considering the red phase in Ontario. McInraith states that the species is migratory there, to a certain extent, and it is probable that some of the red birds may be chance visitors that have come north with others. With this exception the gray belt is unbroken from Picton, Nova Scotia, through New Brunswick; northern Maine, New Hampshire, Vermont and New York; the southern part of Quebec and Ontario; northern Michigan and Wisconsin; a strip through central Minnesota, thence south-westward across Dakota and most of Nebraska, and ending in a long point near Leavenworth, Kansas. On the south this gray belt is somewhat broken as shown on map 2; in the future more complete data may show it as unbroken here from east to west as it is on the north. Beginning at a point near St. Augustine, in Florida, it encompasses nearly the whole of that state and much of the range of the Florida form, *Megascops a. floridanus*; runs northward and westward to Eufaula in

Alabama, and terminates near Mobile (this terminal point is arbitrary); while in Texas it is resumed in the southwestern portion of the range of *mccallii.*[3]

Next to this belt comes that wherein both phases occur, but where the gray predominates. It begins near Belfast, Maine, follows the exclusive gray belt with irregular outline to its termination in northern Kansas, and continues southward in a broad belt into Louisiana, where it is a question whether or not it becomes broken at New Orleans. Immediately north of New Orleans it begins again at Mandeville, La. (based on specimens in Am. Museum), and continues eastward to the coast in the neighborhood of Savannah. In its northern half it sends a long arm southward, through eastern Massachusetts, into central Rhode Island and Connecticut, again in Western Pennsylvania, it reaches in a narrow strip far down the Alleghanies into Virginia and West Virginia, terminating near latitude 37°, covers practically the whole of Ohio, with a good share of Indiana, and continues thence to Leavenworth, Kansas, the delta of the Mississippi, and to the Atlantic.

Within this area lies the region in which both forms occur, but in which *red* largely predominates (which in turn includes the exclusive red areas), and which occupies nearly one-half the area inhabited by *asio* proper. It of course conforms to the outline of the last described belt, and extends along the entire Atlantic coast from New England to Savannah.

Lastly are the two areas where *red* is the exclusive form. The one of considerable size and importance based upon substantial evidence, lies wholly within the Mississippi Valley: the other, a small strip, extends from a little northwest of Oakdale, North Carolina, to Variety Mills, in Virginia, and including Wytheville. At present the grays are apparently unknown from these areas. It has been impossible to examine material from either, and to those who may have the opportunity, I would point out the desirability of collecting all the specimens possible.

---

[3] The intermediate region is mapped upon very insufficient data, it being next to impossible to learn anything of this territory, but the best has been done that was possible under the circumstances.

he following table shows the data arranged by states, upon ch the map (No. 2) of color distribution is based. The inal letters had to be consulted in many cases as to the per placing of the lines marking the several divisions; the e itself shows but two things: the areas where reds or ys are the exclusive form known, and where each predomies in the mixture of the two; the finer distinctions it is of rse impossible to show in tabular form.

; will be remembered from quotations at the beginning, ; the young produced by parents of different colors were l to be either all red, all gray, or both; that those produced parents both of which were *red* were the same; this much rue, *but not a single record can be found of the offsprings of a* · *of gray birds showing the slightest trace of red.* That the ys invariably breed true even in a region where red is the lominating color, *and where the individuals in question may iselves be the offspring of red parents,* is of itself a strong point upport of the theory that the gray was the ancestral color. ther, taking into consideration that there are certain areas ire a red bird is unknown, it is evident that the grays do ainly produce young the color of their parents; and that ire we take the red birds over a very large area and find n continually producing gray birds *together* with red, and ipare them with the gray birds which *never* produce a red; it ıld appear that the gray bird was the original stock, and that red was an offshoot—a branch, so to speak, which, owing to ain climatic conditions, or certain elements in the environ-it, gave it the supremacy in the struggle for existence, and ; the producing of gray birds by red parents is an evident lency to revert to ancestral characters. Nor is that old kim in natural history, *natura non facit saltum* to be ignored; t natural selection played and is playing an important t in the matter is evident, else how came that area in ch the grays are entirely absent? That the red birds e a 'sport,' or a freak, and suddenly acquired their charac-, is not to be supposed for a moment; but on the theory of production with variation' and 'natural selection,' I hold t some slight deviation from the parent stock did at one

TABLE SHOWING DATA BY STATES, UPON WHICH MAP OF COLOR DISTRIBUTION IS BASED.

State.	Red.	Gray.	Source of Information.
Alabama.		Eufaula.	E. L. Brown.
Arkansas.	Cerro Gordo.		Chas. A. Strawn.
	Clinton.		Mrs. Lillie Pleas (Oologist, VIII, 1891, 195).
Connecticut.	Portland.		Jno. H. Sage.
		East Hartford.	Willard E. Treat.
Delaware.	Wilmington.		Walter D. Bush.
Florida.		Palatka.	Jas. Sands.
		Thonotosassa.	W. H. Steacy.
		Citronelle.	Wm. H. Jeremiah.
Georgia.		Faceville.	W. B. McDaniel.
Illinois.	Mt. Carmel.		R. Ridgway (Nat. Hist. Surv. Ill., I, 1889, 417.)
	Odin.		C. B. Vaudycook.
	Jacksonville.		Chas. W. Tindall.
	Warsaw.		Chas. K. Worthen.
	Rockford.		J. E. Dickinson.
	Glen Ellyn.		B. T. Gault.
Indiana.		Camden	Trans. Ind. Hort. Soc., 1890, 52.
	Terre Haute.		Trans. Ind. Hort. Soc., 1890, 52.
		Dunreith.	C. E. Pleas.
	Richmond.		Mrs. Lillie E. Pleas.
	Indianapolis.		Fletcher M. Noe.
Iowa.	La Porte City.		Geo. D. Peck.
		Sioux City.	Dr. Guy C. Rich.
	Grinnell.		Lynds Jones.
Kansas.	Argentine.		G. E. Stilwell.
		Manhattan.	D. E. Lantz.
Kentucky.		Ellis.	Dr. Louis Watson.
	Morganfield.		C. J. Lemen.
	Garrard Co.		G. V. Young.
	Versailles.		L. O. Pindar.
	Bell.		Carrington C. Bacon.
Louisiana.	New Orleans.		Gustave Kohn.
		Mandeville.	Collection Aus. Mus. Nat. Hist.
Maine.		Bangor.	Harry Merrill.
Maryland & Dist. of Columbia.	Washington.		A. E. Colburn.
	Washington.		Wm. Palmer.
	Washington.		C. W. Richmond.
	Washington.		J. D. Figgins.
	Washington.		E. M. Hasbrouck.
	Sandy Spring.		James P. Stabler.
	Laurel.		Geo. Marshall.
Massachusetts.	North Stoughton		C. A. Rummey.
		Boston.	Wm. Brewster & E. W. Ricker.
	Holyoke.		W. F. Lamb.
	Taunton.		A. C. Bent.
Michigan.	Grand Rapids.		Stewart E. White.
	Kalamazoo.		Morris Gibbs.
		East Saginaw.	Peter Lepp.

STATE.	RED.	GRAY.	SOURCE OF INFORMATION.
Minnesota.	Rochester.		W. D. Hurlbut.
		Lake City.	E. A. Wise.
Mississippi.	Waverly.		G. V. Young.
Missouri.	Fayette.		J. W. Kilpatrick.
		Butler.	Harvey Clark.
		Independence.	Charles W. Tindall.
Nebraska.		Ong.	Joel Nelson.
	London.		Geo. A. Coleman.
New Hampshire.		Milford.	J. P. Melzer.
	Webster.		Charles F. Goodhue (F. & S., VIII, 118).
New Brunswick.		New Castle.	Phillip Cox.
New Jersey.	Morristown.		Specimens in Am. Mus. Nat. Hist.
New York.		Albany.	B. W. Arnold.
		Oneida Co.	B. W. Arnold.
		Lowville.	C. Fred. Boshart.
		Lockport.	J. L. Davison.
		Owego.	J. Alden Loring.
		Binghampton.	Willard N. Clute.
		Port Byron.	E. M. Hasbrouck.
North Carolina.	Oakdale.		Robt. J. Thompson.
	Weaverville.		J. S. Cairns.
	Raleigh.		H. H. & C. S. Brimley.
Nova Scotia.		Pictou (?).	Prof.A.M.McQuarrie & Prof.McCulloch
Ohio.		Ney.	Jno. O. Snyder.
		Hamilton.	Geo. Harbron & Dr. F. W. Langdon.
		Canton.	R. H. Bulley.
	Cincinnati.		John. W. Shorten (Jour. Cin. Soc. Nat. Hist., VIII, 1885, 52).
		Lebanon.	Raymond W. Smith.
		Salineville.	Wm. A. Savage.
Ontario.		Plover Mills.	Robert Elliott.
		Lansdowne.	C. J. Young.
		Yarker.	John Ewart.
		Danville.	Dr. G. A. McCallum.
		Hamilton.	T. McIluraith.
		Bradford.	A. C. Sloam.
		Listowell.	Wm. D. Kells.
		Annan.	A. C. Sloam.
		Ardtrea.	John Blair.
		Toronto.	James R. Thurston.
		Belleville.	James T. Bell.
Pennsylvania.	Philadelphia.		Chas. A. Voelker (Proc. Del. Val. Orn. Club, I, '90–'91, p. 12).
	Williamsport.		August Koch.
		Scranton.	Arthur B. Williams, Jr.
Rhode Island.		Providence.	Chas. E. Doe.
	Pawtucket.		H. A. Cash.
		Providence.	H. A. Cash.
South Carolina.	Mount Pleasant.		Arthur. T. Wayne.
	Beaufort.		Walter Hoxie.
Tennessee.	Duck River.		J. B. Cathey.
	Tazewell.		B. F. Schultz.
Texas.		Giddings.	J. O. Singley.
		San Antonio.	H. P. Attwater.
		Gainesville.	G. H. Ragsdale.

STATE.	RED.	GRAY.	SOURCE OF INFORMATION.
Texas.	Tyler.		W. L. McDaniel.
		Travis Co.	Chas. D. Oldright.
Vermont.		East Berkshire	G. B. Hopkins.
		Strafford.	Chas. P. Collins.
		Lunnenburg.	W. E. Balch.
		Castleton.	A. O. Johnson.
		St. Johnsbury.	Franklin Fairbanks.
Virginia.	Variety Mills.		H. M. Micklem.
	Wytheville.		John B. Barrett, Jr.
		Eagle Rock.	J. T. Paxton.
		New Market.	Geo. M. Neese.
West Virginia.	Charlestown.		B. W. Mitchell.
		French Creek.	Earle A. Brooks.
		White Sulphur Springs.	Thaddeus Surber.
Wisconsin.	Madison.		Chas. F. Carr.
	Madison.		Wisconsin Nat. Vol. I, 188.
	Racine.		Dr. P. R. Hoy.
	Jefferson.		Ludwig Kumlein.
		Pewaukee.	B. F. Goss.

time occur, which in some way better fitted the individual for the struggle for existance. Through countless generations this has been perpetuated by the inter-breeding of those possessing it, in consequence, the grays, as has been seen (see map), have entirely disappeared in at least one portion of the country, and have become extremely rare in others. Many difficulties exist, both in showing the original condition, and in explaining the present state of affairs. In early scientific work, as is well known, no attention whatever was paid to matters of this nature, consequently it is impossible to ascertain the proportion of red and gray birds at a period say four hundred years ago—still, I hope to reason by analogy. As for the possible causes influencing the change, they will be found fully treated in their proper place; at present the theory is either to be proved or disproved.

Assuming that the gray was the ancestral stock, and that the producing of gray birds by red parents is a tendency to revert to ancestral characters, an analogous case will be found in Darwin's own experiments.

As is well known, many of these were performed with pigeons, which proved to be the best subjects, and the following is quoted from the "Origin of Species:"[1]

---

[1] Origin of Species, pp. 17–19.

"Great as are the differences between the breeds of the pigeon, I am fully convinced that the common opinion of naturalists is correct, namely, that all are descended from the rock pigeon, *Columba livia* * * * * * The rock pigeon is of a slaty blue with white loins, * * The tail has a terminal dark bar, with the outer feathers externally edged at the base with white. The wings have two black bars. * * Now in every one of the domestic breeds, taking thoroughly well bred birds, all the above marks, even to the white edging of the outer tail feathers, sometimes occur perfectly developed. Moreover, when birds belonging to two or more distinct breeds are crossed, none of which are blue or have any of the specified marks, the mongrel offspring are very apt suddenly to acquire these characters." (If this be true of distinct species, how much more is it true of different color phases of the same species). "To give one instance out of several I have observed: I crossed some white fantails, which breed very true, with some black barbs—and it so happens that blue varieties of barbs are so rare that I never heard of an instance in England, and the mongrels were black brown and mottled. I also crossed a barb with a spot, which is a white bird with red tail and red spot on the forehead, and which notoriously breeds very true; the mongrels were dusky and mottled. I then crossed one of the mongrel barb-fantails with a mongrel barb-spot, and they produced a bird of as beautiful a blue color, with the white loins, double black wing bar, and barred and white edged tail feathers, as any wild rock pigeon! We can understand these facts, on the well known principle of reversion to ancestral characters, if all the domestic breeds are descended from the rock pigeon."

Now if this reversion to ancestral characters occurs in breeds so far removed from the parent stock and from each other—how much more is it reasonable to suppose that a color phase of the screech owl, when found continually producing gray birds, while gray birds produce grays alone—is but a repetition only between birds more closely related, of the same performance?

(*To be continued.*)

THE CINNAMON HARVEST-SPIDER AND ITS VARI TIONS.

BY CLARENCE M. WEED.

In his monograph of the Phalangiidæ, published[1] in 18 Dr. H. C. Wood described a well-marked harvest-spider *Phalangium ventricosum.* The description was drawn up fr a single female taken near Philadelphia, and specimens o male Phalangium collected in West Virginia supposed belong to the same species. Besides these Dr. Wood had number of female harvest-spiders from Nebraska "which p sent apparently the same specific characters as the form except that the legs are a little shorter. Suites of specime from the two localities would however probably show them be distinct."

In the same paper, Dr. Wood described as *Phalangi formosum* another well-marked form found in spring.

Aside from a mention in 1869 by Dr. Packard in his Gu to the Study of Insects (p. 657), and a bibliographical refere in 1885 by Professor Underwood,[2] these species appear not have been noticed in our literature for nearly twenty yea Since then, however, I have referred to them in a number papers.

My first mention was published in 1887[3] when I provisi ally referred *P. formosum* to the genus Liobunum, and c jectured, without having seen specimens, that *P. ventricos* also belonged to that genus. Two years later I publish extended descriptions of *P. formosum* referring it to Liobun "with considerable hesitancy, as it does not strictly belo there on account of the projecting inner angle of the pal patella."

[1] Comm. Essex Institute, Vol. VI.

[2] Con. Ent., XVII, 169.

[3] Amer. Nat., XXI, 935.

[4] Bull. Ill. St. Lab. Nat. Hist., III, 91.

These forms were next discussed in my paper on "The Harvest-spiders of North America,"[5] in which *P. ventricosum* is definitely placed in Liobunum, and *P. formosum* together with a southern form not before described is referred to the new genus Forbesium. The new form is named *F. hyemale.* "The former (*F. formosum*) is a distinctly northern species, ranging from New York to Colorado, while the latter (*F. hyemale*) is evidently its southern representative."

Finally in the AMERICAN NATURALIST for September, 1892, I announced that by keeping specimens of *F. formosum* taken in early spring in vivaria, I had determined that it was the immature form of *L. ventricosum*; and about the same time I published[6] extended descriptions of adults of both sexes of *L. ventricosum.*

For the purposes of the present study I have had a considererable number of adult specimens from nine widely separated states, viz.; Maine, New Hampshire, New York, Ohio, Michiigan, Illinois, Nebraska, North Carolina and Mississippi. Besides the adults I have had an immense number of the immature form (*formosum*) and a few of the form at present called *F. hyemale.*

The first glance at the adult specimens shows that there is a great variation in the size of the body and length of legs in different localities. The Mississippi forms are twice as large as those from New Hampshire; while those from the states between present intermediate sizes. This is shown by the measurements in millimeters in the following table; numbers 1 to 6 are males, and 7 to 12 females.

To show graphically the gradual lengthening of the legs of this harvest-spider as it goes southward I have reduced the length of the second pair, as given in this table, to the straight lines reproduced on the opposite page. The Mississippi specimens were taken at the Agricultural College in the central part of the state. I regret that I have not more specimens from the region between Ohio and Mississippi to show the transition more completely.

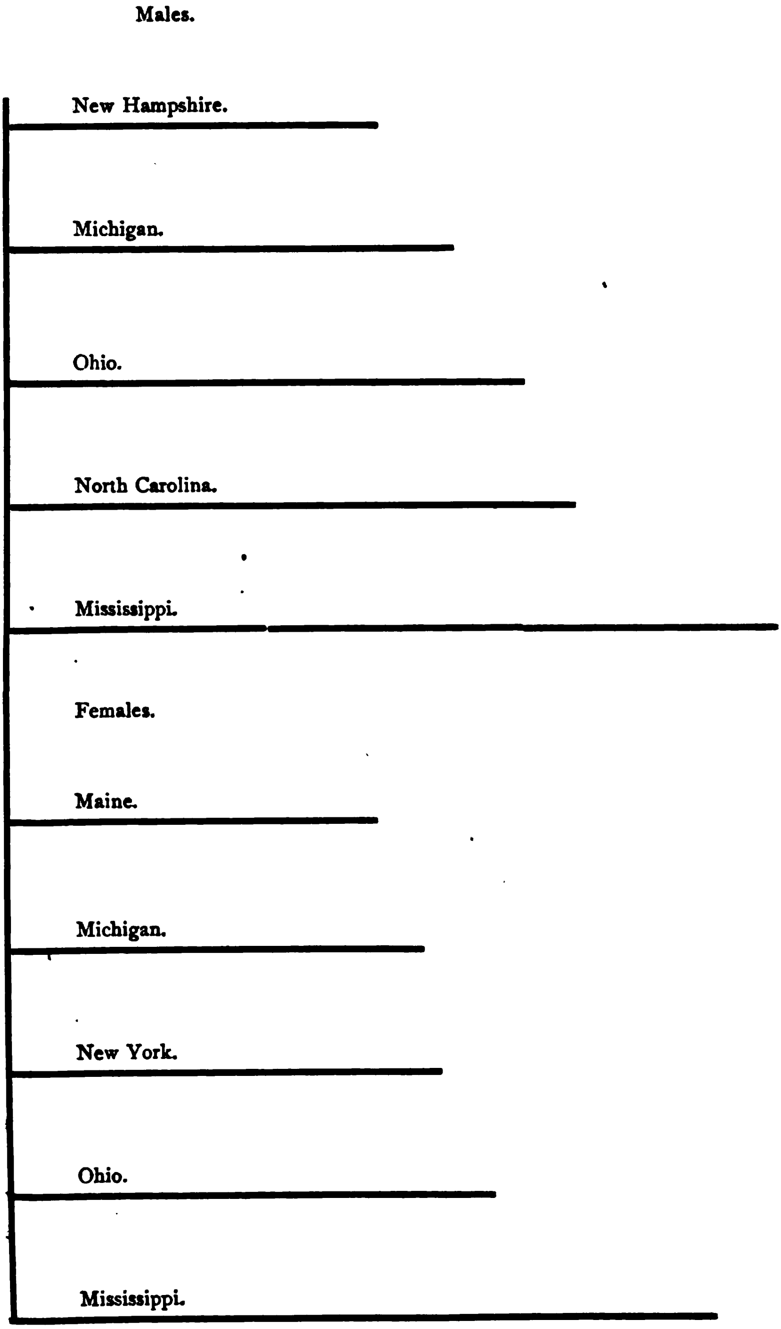
---

[5] Am. Nat., Oct., 1890.

[6] Trans. Am. Ent., Soc., XIX, 188.

Table I.—Variations of *Liobunum ventricosum.*

Number of Specimen.	Locality	Body.		Legs.			
		Length	Width	First	Second	Third	Fourth
1	New Hampshire	5.8	4.	27.5	47.5	28	36.5
2	Michigan	7.	4.4	27.5	55.5	26	42.
3	"	7.1	4.2	28.	57.5	29	44.6
4	Ohio	7.6	5.	36.5	67.5	36	—
5	North Carolina	8.	5.	44.	74.	—	—
6	Mississippi	9.	6.	52.	101.	50	73.
7	Maine	9.	5.6	25.	47.	24	—
8	New York	10.2	5.5	27.8	55.	27	39.
9	Michigan	10.	6.	28.	53.	28	40.
10	Ohio	10.	6.	—	62.	—	48.6
11	Mississippi	13.4	7.	46.	89.	44	—
12	"	11.	6.2	48.	93.5	46	68.


Males.
New Hampshire.
Michigan.
Ohio.
North Carolina.
Mississippi.
Females.
Maine.
Michigan.
New York.
Ohio.
Mississippi.

Like other harvest-spiders this species also varies considerably in a given locality. It is so rare that it is difficult to get long series from one place so that I cannot tabulate at present these variations as fully as has been done for *Phalangium cinereum* and *Liobunum vittatum dorsatum.*[1] To indicate the variation that sometimes occurs in a single state I may record that of two specimens from Dover, New Hampshire, measured since the above tables were prepared, the body of the male was 8 mm. long, and the second legs 63 mm., while the body of the female was 10 mm. long, and the second legs 50 mm. The second legs of this male specimen were 15.5 mm. longer than the one from Hanover recorded in the table. It should be stated however that Dover is distinctly within the region of the Alleghanian fauna, and Hanover is on the border between the Alleghanian and Canadian faunas.

A study of all the specimens of my *Forbesium hyemale* now accessible leads to the conclusion that this is the immature stage of the southern form of *L. ventricosum,* just as Wood's *P. formosum* is the immature stage of the northern form of this species. The dissection of specimens shows that they are not sexually mature, and the dates of capture indicate that they disappear late in spring or early in summer at the time the

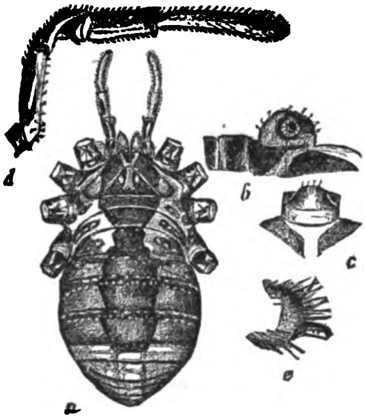


FIGURE 1.—*Liobunum ventricosum.* Immature: *a,* body; *b,* eye eminence, side view: *c,* same, front view; *d,* palpus; *e,* palpal claws; all magnified.

---

[1] AMERICAN NATURALIST, Vol. XXVI, pp. 34–36.

adult *L. ventricosum* appear. This is precisely the condition in the northern states. An idea of the similarity of the two immature forms in structural details may be obtained by comparing Fig. 1 with Plate XIV, Fig. 2.

The southern form of *L. ventricosum* should evidently be considered a geographical race sufficiently distinct for subspecific name. Inasmuch as *hyemale* has already been applied to the stage immediately preceding the adult it may well be used for this race, and the form be known as *Liobunum ventricosum hyemale.* Just where the line dividing the two forms should be drawn is difficult to say without more material, but it probably occurs near the latitude of southern Ohio.

LAWS OF VARIATION IN HARVEST-SPIDERS.

Comparatively little definite investigation of the geographical variation of North American invertebrates has yet been undertaken. In the vertebrates—especially birds and mammals—much attention to the subject has been given by Baird, Allen and other well-known zoologists, so that a number of general laws have been formulated.[8] To determine to what extent these laws hold true for the invertebrates, as represented by the Phalangiidæ, I have ventured to formulate some of the results obtained in my studies of this group—results which in part have already appeared in the NATURALIST and in part are yet unpublished. At the present stage of investigation such formulæ cannot be considered as final by any means, but if they serve no other purpose they will be useful in determining the direction of future work.

(1.) In mature individuals of the same species and sex from a given locality there may be found a decided variation in size of body and length of legs. In a series of fifty or a hundred such individuals taken at random the body of the largest specimen will usually be from one-fifth to one-fourth longer than that of the smallest; and the legs of the longest-legged individual are likely to be from one-fifth to one-third longer than those of the shortest-legged specimen.

---

[8] See the AMERICAN NATURALIST, Vol. XXVI, pp. 87–89.

(2.) As a rule, not without exceptions, the legs vary together in a given direction; that is, if in a certain individual the first pair are longer than the first pair of another individual, the other legs of the former are likely to be longer than the corresponding legs of the latter. The hind legs are the most irregular in their variation.

(3.) There is a gradual increase in size of body and length of legs in the individuals of a species from the north, southward at least as far as latitude 37° in the Mississippi Valley. near which region the sub-family Phalangiinæ appears to attain its maximum development.

(4.) The proportionate increase in the length of the legs to the southward appears to be greater than that of the body.

These last two propositions are true of all the harvest-spiders having an extended northern and southern distribution studied with reference to their variations, viz; *Liobunum vittatum*, *L. ventricosum*, *L. politum* and *L. longipes*. Probably the most important factor in determining this increase in size is to be found in the climatic conditions which permit a longer period of growth and feeding at the south than in the north. The arachnids undergo no definite series of molts, simply casting their skins as increase in size requires. Such climatic conditions, combined presumably with a more abundant food supply, may tend, apparently, to increase the size of these harvest-spiders by at least three methods:

(*a*.) By the direct effect of a long warm period of growth with abundant food upon the individual before attaining its full size.

(*b*.) By the effect of a long period of development of the eggs in the ovaries of the female.

(*c*.) By the action of the eliminating principle in natural selection in fostering those individuals which attain the maximum size compatible with their environment.

This increase in size of individual may possibly be of benefit to the species (1) by enabling it to prey upon larger insects, thus increasing the source and variety of its food-supply; (2) by enabling it better to elude predaceous enemies, or (3) to catch fleeing prey.

In the plains region of the Northwest (Dakota, Nebraska) gs are considerably shorter than in similar latitudes in England.

r example, the second legs of a male *Liobunum longipes* Brookings, South Dakota, measure 62 mm., while those Hanover, New Hampshire specimen measure 74 mm. case of the Striped Harvest-spider (*L. vittatum dorsatum*) ll more striking; the second legs of a New Hampshire men measure 71 mm., while the normal length in South ta seems to be only 35 mm.

addition to the above the following laws of vertebrate tion appear to hold good in the Phalangiidæ.

"The maximum physical development of the individual ained where the conditions of environment are most able to the life of the species.

) "The most typical or most generalized representatives group are found near its center of distribution, outlying being generally more or less aberrant or specialized."

Explanation of Plates.

XIII. Fig. 1.—*Liobunum ventricosum* (Wood), male. Natural size.
" 2.—Parts of same. Magnified.
" 2*a*.—Body.
" 2*b*.—Eye eminence. Side view.
" 2*c*.—Eye eminence. Front view.
" 2*d*.—Palpus. Side view.
" 2*e*.—Claw of palpus. Side view.
" 2*f*.—Maxillary lobe of second pair of legs.

XIV. Fig. 1.—*L. ventricosum hyemale.* Immature. Natural size.
" 2.—Parts of same. Magnified.
" 2*a*.—Body.
" 2*b*.—Eye eminence. Side view.
" 2*c*.—Eye eminence. Front view.
" 2*d*.—Palpus. Side view.
" 2*e*.—Claw of palpus. Side view.

EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—We have received from the Secretary of the American Philosophical Society, a programme of the exercises on the occasion of the celebration of the 150th anniversary of the foundation of the Society. The celebration commences on Monday, May 22d, at 8 P. M., and continues until Friday the 26th inclusive, and consists of sessions commencing at 11 o'clock A. M., excepting on Monday, when the session opens at 8 o'clock, P. M.

The programme is the work of a committee, and was not submitted to the Society until its terms could not be altered without discourtesy to the persons who had been invited to participate in it. This much is due to the Society, since it is, under such circumstances, not responsible for the committee's work. As to the committee, its work is disappointing, for since there is one member of it who is presumably competent for the work it undertook, he should have been able to so influence the other members as to have produced a widely different result. The adoption of such a programme is to misrepresent the position which Philadelphia holds in the wide field of labor covered by the Society, since it does not include any paper or address by any one of its citizens presenting his own original work in art, science or philosophy. On the contrary, the best that can be said of the programme is that its subject-matter, so far as contributed by Americans, consists of those generalities to which popular assemblies are wont to be treated, and, perhaps, entertained, if not satisfied. For a Society whose fundamental object is the "increase of knowledge," to occupy its time in platitudinous disquisitions of this kind, displays a misconception of its own position and, a lowering of the standard of achievement which it is of all the societies in this city called upon to bear.

When an active Society, such as the one in question, celebrates an anniversary of significance, it usually presents to the world some evidence of its activity by securing for the occasion the services of such of its members as are competent so to do. Such occasions are usually selected for the announcement of the results of their work before the wider audience which the occasion is expected to attract. A memorial volume of permanent value is the usual result.

As an illustration, in 1880, the Boston Society of Natural History celebrated the fiftieth anniversary of its foundation. A memorial volume was issued, which includes the papers read on that occasion, and it is a monumental work. The same course should have been pursued by the American Philosophical Society. There is no deficiency of workers or of work. The members of this Society produce *original work* in Prehistoric Archeology, Philology and Ancient and Modern History; in Chemistry, Geology Biology; in Political Science, and in pure Philosophy. We emphasize the words *original work.* That none of these men and none of this work appear in the programme will be cause of astonishment both in Philadelphia and out of it.

RECENT BOOKS AND PAMPHLETS.

ALLEN, J. A.—The Geographical Distribution of North American Animals. Bull. Am. Mus. Nat. Hist., Vol. IV, No. 1, Art. XIV, 1892. From the author.

BABCOCK, E. J.—Clays of Economic Value in North Dakota. Issued by H. T. Helgesen, State Commissioner of Agriculture and Labor, Bismark, 1892. From the author.

Bulletin No. 19, Iowa Agricultural Experiment Station, 1893.

Bulletin No. 87, North Carolina Agri. Exp. Station, Nov., 1892.

CLAYPOLE, E. W.—On the Structure of the American Pteraspidian, Palaeaspis (Claypole) with remarks on the Family. Extr. Quart. Journ. Geol. Soc., Vol. XLVIII, 1892. From the author.

DAFERT, E. W.—On the Separation of Minerals of High Specific Gravity. Extr. Proceeds. Rochester Acad. of Sci., Vol. II, 1893. From the author.

DUGES, Dr. A.—Un Nuevo Ixodideo. Extr. La Naturaleza, 2° Tomo, S. 2a. From the author.

DUMBLE, E. T.—Notes on the Geology of the Rio Grande. Bull. Geol. Soc. Am., Vol. III, 1892.

Do.; Report on the Brown Coal and Lignite of Texas. Character, Formation, Occurrence and Fuel Uses, 1893. From the Texas Geological Survey.

EARLE, C.—Revision of the Species of Coryphodon. Extr. Bull. Am. Mus. Nat. Hist., Vol. IV, No. 1, Art. XII. From the author.

EVERMANN, B. W.—Description of a New Sucker, *Pantosteus jordanii*, from the Upper Missouri Basin. Extr. Bull. U. S. Fish Com., 1892. Date of pub., Jan. 27, 1893. From the author.

FARQUHAR, H.—Competition and Combination in Nature. Extr. Proceeds. A. A. A. S., Vol. XLI, 1892. From the author.

FRAZER, P.—Biographical Sketch of Thomas Sterry Hunt. Extr. Am. Geol., Jan., 1893. From the author.

GALLOWAY, B. T.—Report on the Experiments made in 1891 in the Treatment of Plant Diseases. Bull. No. 3. Div. Veg. Path. U. S. Dept. Agri. From the Smithsonian Institution.

HATCHER, J. B.—The Ceratops Beds of Converse County, Wyoming. Extr. Am. Journ. Sci., Vol. XLV, 1893. From the author.

HENDERSON, C. H.—The First Cretaceous Fold of the Alps between the Linth and the Sihl. Inaugural Dissertation Presented to the Philosophical Faculty of the University of Zürich, for the Degree of Doctor of Philosophy, 1892. From the author.

HERRICK, C. L.—Additional Notes on the Teleost Brain. Separat-Abdruck Anat. Anzeiger, 1892, No. 13 and 14.

——Notes upon the Histology of the Central Nervous System of Vertebrates. Separat-Abdruck aus der Festschrift zum siebenzigsten Geburtstage Rudolf Leuckarts, From the author.

HICKS, L. E.—Some elements of Land Sculpture. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

KINGSLEY, J. S.—The Embryology of Limulus. Extr. Journ. Morph. Vol. VII, 1892.—From the author.

KUNTZ, G. F.—Precious Stones. Extr. from Rept. on Mining Industries in the United States at the Eleventh Census, 1890.——On Five New American Meteorites. ——Mineralogical Notes on Brookite, Octahedrite, Quartz and Ruby. Extrs. Am. Journ. Science, Vol. XLIII, 1892.——Bohemian Garnets. Extr. Trans. Am. Inst. Mining Engineers, 1892. From the author.

KUNTZ, G. F. UND E. WEINSCHENK.—Meteoritenstudien; Separat-Abdruck aus Tschermak's Mineralog. u. petrograph. Mittheilungen, herausgegeb. von F. Becke, XII, Band 3, Heft Wein, 1892.——Farmington, Washington Co., Kansas Aerolite. ——On two Meteoric Irons. Extrs. Amer. Journ. Sci., Vol. XLIII, 1892.

LEWIS, T. H.—De Soto's Camp in the Chicksaw Country in 1540–41. Extr. National Mag., Nov., 1891.——The "Old Fort" of Saline County, Missouri. Extr. Am. Antiquary, May, 1892. From the author.

LYMAN, B. S.—Report on the Shippen and Wetherill Tract, Schuylkill Township, Schuylkill Co., Pa. Phila., 1893. From the author.

MORRIS, R. T.—Is Evolution trying to do away with the Clitoris? Extr. Am. Journ. Obstetrics, Vol. XXVI, No. 6, 1892. From the author.

OSBORN, H. F. AND J. L. WORTMAN.—Characters of Protoceras (Marsh), a New Artiodactyle from the Lower Miocene. Extr. Bull. Am. Mus. Nat. Hist., Vol. IV, No. 1, Art. XVIII, 1892.—From the authors.

POULTON, E. B.—Further Experiments upon the Colors of certain Lepidoptera. Trans. Ent. Soc. London, 1892, Part IV. From the author.

Proceedings of the American Association for the Advancement of Science, 1892.

PROSSER, C. S.—Notes on the Geology of the Skunnemunk Mountain, Orange Co., New York. Extr. Trans. New York Acad. Sci., Vol. XI, 1892. From the author.

——The Thickness of the Devonian and Silurian Rocks of Central New York. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

PUTNAM, F. W.—Report of the Peabody Museum of American Archaeology and Ethnology, 1892.

RHOADS, S. N.—Hybridism Exemplified in the Genus Colaptes. Extr. Science, Dec., 1892.

——Notes on Certain Washington and British Columbia Birds. Extr. The Auk, Vol. X, 1893. From the author.

SCOTT, W. B.—The Evolution of the Premolar Teeth in the Mammals. Extr. Proceeds. Phila. Acad. 1892. From the author.

SCUDDER, S. H.—Some Insects of Special Interest from Florissant Colorado, and other points, in the Tertiaries of Colorado and Utah. Bull. 93 U. S. Geol. Survey. From the Smithsonian Institution.

SCHENCK, J.—Some Common Errors in the Physical Training, Education and Dress of Girls. Extr. Trans. Ill. State Med. Soc., 1892. From the author.

SEELEY, H. G.—On a New Reptile from Welte Vreden, *Eunotosaurus africanus* (Seeley). Extr. Quart. Journ. Geol. Soc., Nov., 1892. From the author.

SHUFELDT, R. W.—Comparative Notes on the Swifts and Humming-Birds. Extr. Ibis, Jan., 1893.

——Notes on the American Bittern. Extr. The Auk, Jan., 1893. From the author.

SIEBENROCK, F.—Ueber Wirbelassimilation bei den Saurien. Ann. des K. K. Naturhistorischen Hofmusems; Separat abdruck aus Band VII, Heft 4, 1892. From the author.

SNYDER, M. B.—Report of Special Correspondence presented at the Feb. Meeting of the Educational Club of Philadelphia, 1893. From the author.

TOWNSEND, C. H. T.—Catalogue of the described South American Species of Calyptrate Muscidae. Extr. Ann. New York Acad. Sciences, Vol. VII, 1892. ——A Blood-sucking Gnat of the Family Chironomidae. Extr. Psyche, Vol. VI, 1892.——A General Summary of the Known Larval Food-Habits of the Acalyptrate Muscidae; a Preliminary Grouping of the Described Species of Sapromyza of North America, with one new species; Notes on North American Tachinidae with descriptions of New Genera and Species; Biologic Notes on New Mexico Insects. Extrs. Canadian Entomologist, 1892. From the author.

WALCOTT, C. D.—Notes on the Cambrian Rocks of Pennsylvania and Maryland, from the Susquehanna to the Potomac. Extr. Am. Journ. Science, Vol. XLIV, 1892.

——Preliminary Notes on the Discovery of a Vertebrate Fauna in Silurian (Ordovician) Strata. Extr. Bull. Geol. Soc. Am., Vol. III, 1892. From the Society,

WARD, L. F.—Address before the Section of Economic Science and Statistics, A. A. A. S., 1892. From the author.

WILCOX, J.—On the Evolution of the Earth and the Heavenly Bodies. Read before the Delaware Inst. Sci., Dec., 1892. From the author.

WINCHELL, H. V.—The Mesabi Iron Range. Extr. Twentieth Annual Rep. Minn. Geol. Surv.

RECENT LITERATURE.

Evolution of the Colors of North American Land Birds.[1]—This octavo of 361 pages, published by the California Academy of Sciences, the author Mr. Charles A. Keeler, modestly calls a study. The views set forth are more or less provisional and tentative, and are intended to direct research into this new field of ornithological inquiry. The subject-matter of the essay is preceded by a discussion of the various views held as to the laws conditioning evolution, such as inheritance of acquired characters; the nature of species; natural and sexual selection, and isolation, as factors in the evolution of species. In concluding this rather lengthy introduction, the author remarks " that life has evolved in accordance with tolerably definite and unvarying laws, and that the element of chance, if any such there be, is a very limited one."

In Part II the colors of North American birds, are treated of under the following heads: Modes of plumage changes; General principles of color in Birds ;. The proportion and distribution of the colors in the North American genera; The pattern of markings; Variation of color with sex, age and season; The direct influences of the environment; Geographical distribution as a factor in the evolution of colors; Orders, families and genera of North American Birds, considered from the stand-point of their evolution.

The theory of bird colors which Mr. Keeler seeks to establish is as follows: Pigment is a chemical composition thrown off from the system of the bird, probably as a product of waste, and lodged in the integument. The chemical substance thus generated varies in different groups of birds, but is probably generally constant in the species of one genus, or frequently in an entire family. A certain genus would thus be capable of generating only a given number of fundamental colors, but natural and sexual selection by combining and rearranging this limited assortment can produce a variety of effects.

Associated with this theory is the Law of Assortment of Pigments; that is, that the primitive color is a composite which, when more or less completely resolved into its component elements gives the specialized tints of the species or genus. If the system of the bird from which some of the present highly colored genera were evolved produced normally two pigments, unless some distributing force were brought to bear upon them, they would naturally be combined at first. It is only after long selection that the component colors become apparent. The examples cited are, as might be expected, among the most highly specialized genera. The woodpeckers are colored black, white and scarlet. The combination would produce brown, which is still the body color of some species. In the genus Tyrannus the original color was probably olive green, the special colors are black and yellow. In the blue jays that are blue in the adult together with black and white, the mixture of these colors gives the grays of the young, and of the less specialized forms, as Perisoreus and Picicorvus. Besides black and white, most North American genera appear to contain but two fundamental colors, but in the tropics three frequently occur in a single genus.

---

[1] Evolution of the Colors af North American Land Birds. Occasional Papers of the California Academy of Sciences III. By Charles A. Keeler. San Francisco, January, 1893.

In discussing protective coloring, repetitive marks, and recognition marks, the most recent literature upon this subject is cited and illustrated with numerous facts of the author's own observation.

Having considered the factors that influence the evolution of colors of North American birds, Mr. Keeler gives a brief account of the families and genera with an application of the principles discussed.

Mr. Keeler's review of the factors of organic evolution is comprehensive and intelligent. He appreciates the fundamental difference between the origin of characters and the selection of characters, though occasionally he slips into the customary confusion on this point by ascribing the origin of some color marks to natural selection. The reviewer takes this opportunity to refer to one misunderstanding into which he in common with many others has fallen, in his reference to effort as prior to use in developing structure. He says (p. 75) "All that can be said to the above [the theory of effort] is that it may be true but that it has not yet been demonstrated. There is indeed a vast difference between the assumption that use can modify a part which already exists, and the assumption that desire or effort can originate something which does not exist. Moreover, even if effort be a valid factor in creation, it cannot it seems to me have the general application ascribed to it by Professor Cope. For example, it could apparently have no influence on the origination of new colors. Does the bird desire to be protectively colored? If so it must decide what colors would be most in harmony with its surroundings, and then make an effort of will to have these colors developed; all of which is on the face of it inconceivable. Or by what imaginable sort of effort could feathers be originated? Effort then, if it can be shown to have any creative power, must be relegated to a very special field, and cannot be considered as the sole or even principal originator of the fittest."

The above paragraph indicates a radical misconception of the proposition.

Effort is simply the conscious preliminary to motion, and motion is the fundamental efficient cause of the leading modifications of structure. No knowledge or intention as to the result or effect (final cause) of the motion is to be supposed. It is motion which changes the environment of an animal, and which is thus at the bottom of whatever results from that change, let the immediate efficient agency be physical, chemical or mechanical. The psychic cause of this effort is a sensation. Of course in purely reflex acts, effort (which is assumed to be conscious by its definition), is wanting, but the hypothesis sustained in the work quoted by Mr. Keeler, (The Origin of the Fittest), is that reflex acts have had their origin in conscious acts, and are the result of automatization, which is the ordinary process of education. Reflex motions then have had their origin in effort as well as the so-called voluntary acts, but at an earlier period. For this reason they have relatively little to do with the molar movements of animals at the present time, and therefore little to do with the *present* origin of specific characters. It is present effort which precedes most of the motions of animals, and which thus has everything to do with the environment, to which evolutionists of all shades appeal as an efficient cause.

The most important contribution towards the discovery of the origin of colors in birds by Mr. Keeler, is his demonstration of the law of the Assortment of Pigments. His classification of our birds in accordance with their color relations, is a valuable preliminary to further research. When we reach the final stage of the subject, the origin of the tints themselves, no definite progress is made in the book before us. As one of the most difficult problems in organic molecular physics, it requires a very special mode of experimental treatment, and one which Mr. Keeler has not attempted. The origin of color patterns is less difficult of approach, and some progress has been made in this direction, but the subject is yet in a very primitive stage.

The illustrations of the book are numerous and often in colors, and they add greatly to its value. The work is gotten up in excellent style, and is a credit to all concerned in its publication. C.

Wright's Man and the Glacial Period.[1]—This book is the best synopsis of present knowledge of the glacial epochs and its relations to human history which has yet appeared. The compass of the work necessarily does not permit as great detail as would be appropriate to a technical monograph, but it is admirably adapted for the purpose for which it is designed, i. e., that of giving the greatest amount of information in a readable form in the smallest space. The treatment of disputed topics is generally judicial, and the author has brought to bear on the subject a great wealth of facts not only from all published sources, but also from his own original research in North America and Europe. A question of much general interest is that of the age of the great ice period. He brings together evidences from various observers to show that its close cannot have been more than 15,000 years ago, and that its duration may have been twice as long. The basis of this estimate is the rate of cutting of various post-glacial gorges, of which well-known examples are that of the Niagara River, and that of the Mississippi below the falls of St. Anthony. This shortened time is in remarkable contrast to the estimate made by the geologists who first attacked the problem.

The portion of the book relating to the antiquity of man is the smaller half, but the conclusive evidences of man's existence during the glacial epoch are necessarily local. Such evidence as this is handled judiciously, and all objections are duly considered. Professor Wright is of the opinion that some of the finds which indicate the existence of man during the glacial epoch are trustworthy evidence to that effect. He cites especially as American localities, Trenton, New Jersey, (Abbott); Newcomerstown and Madisonville, Ohio; Little Falls, Minnesota, Miss Babbitt; Nampa, Idaho, and Calaveras Co., California. These finds will be mentioned again below. He considers the supposed finds of human implements in beds of Neocene age as not established.

Dr. Wright's book has been made the object of a vigorous attack by the geologists of the U. S. Geological Survey in a way which shows an animus on their part not strictly scientific. President Chamberlin in the Chicago Dial, charged the author with improperly alleging on the title page that he was an assistant on the U. S. Geological Survey. To this Dr. Wright replied that he was so employed at the time the book was written and demonstrated satisfactorily his right to use the title assistant. One of the other criticisms was regrettably free from the amenities which should characterize scientific discussion, while others exaggerated unimportant details, and ignored the general value and utility of the book. To all this Dr. Wright has replied temperately and convincingly.

---

[1] Man and the Glacial Period by G. Frederick Wright, D. D. LL. D. International Scientific Series No. LXIX. New York, D. Appleton & Co., 1892.

The ethnologists of the Bureau at Washington have made destructive criticisms of the evidence for glacial man contained in the book. Probably the most expert makers in the world of human implements of the stone age are Messrs Holmes and Maguire of Washington. They show convincingly that it is easier to make neolithic or pecked and polished stone implements, than to make fine chipped flints of paleolithic type. Hence they conclude that either the order of age should be reversed, or that paleoliths and neoliths are of contemporary age, and that the absence of neolithic implements from some deposits is simply due to accident or to the soft material of which such implements were made. This conclusion, if correct, revolutionizes prehistoric archeology. These gentlemen think that it should be

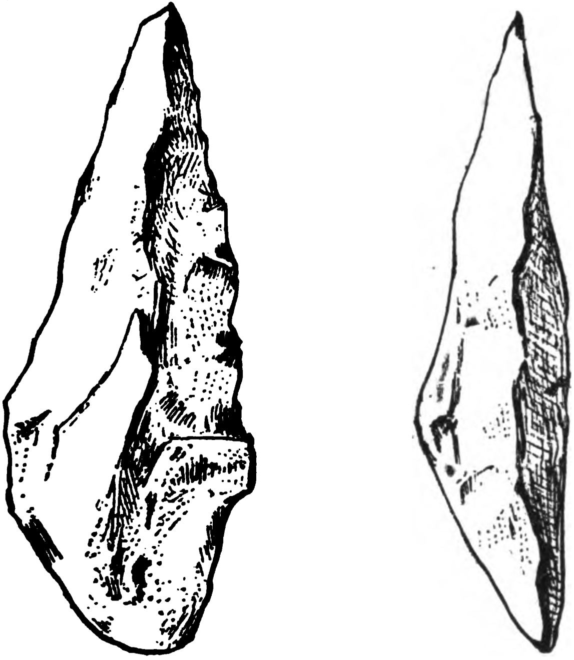


FIG. 1.

Fig. 1. Argillite implement found by Dr. C. C. Abbott, March, 1879 at K. K. Rowan's farm, Trenton, N. J., in gravel 16 feet from surface. From G. F. Wright's Man and the Glacial Period.

revolutionized, and that paleolithic man in both Europe and North America is a myth. The great collections of paleoliths of the turtle-back and Chelléen types they look upon as cores and rejects of pieces from which better implements have been made and taken away. This view leads them to look with suspicion on the alleged discoveries of glacial man, and Mr. Holmes has accordingly written articles discrediting the finds described in Dr. Wright's book.

It may be remarked apropos of the observations of Messrs Holmes and Maguire, that though it may be true that pecked and ground implements are more easily made than well chipped flints their actual relations in time can only be ascertained by stratigraphic and paleontologic research. A flint broken once or twice so as to produce an edge is more easily made than a neolith, and gives a great deal better edge, so that such implements may very probably have antedated the latter, while the finer ones are well-known to have been neolithic, and have been made up to the present day. The question is however, not which implement ought to have come first, but which actually did come first.

As regards the finds in Europe, those of the caves are the result of so much careful investigation, and are characterized by such satisfactory stratigraphic conditions, that they cannot be impeached by observations made in this country. The paleoliths and human bones have been conclusively shown to belong to the age of the glacial fauna. In North America the paleontologic evidence is not so good, but such as there is, indicates strongly that the earliest known American was not more modern than the paleolithic European. Those who saw the Calaveras skull when first found, allege that it was more or less covered with the adherent cement so characteristic of the gold bearing gravel of California. The age of this gravel is not exactly determinable, since data respecting the finding of fossils in it are not generally reliable. But that it is of approximately glacial age no one doubts. Mr. Holmes believes that the implements of the Abbott and Babbitt finds occur only in the talus, and are not from the undisturbed glacial gravels (American Geologist); but so far as regards part of the Babbitt, and all of the Abbott finds, other observers hold a different opinion. In the Journal of Geology he shows that the evidence for the stratigraphic position of the finds at Madisonville and Newcomerstown, Ohio, is defective. It may be added here that the Nampa image, whatever may be its real stratigraphic origin, displays in its form an artistic skill on the part of its maker, not to be looked for in primitive man; nevertheless it is time that the name of the person who alleges

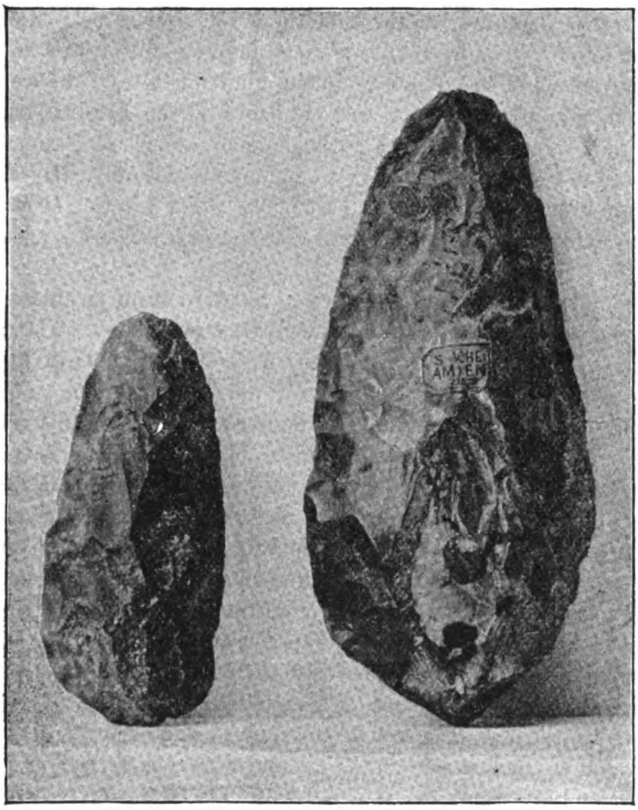


FIG. 2.

Fig. 2. Smaller figure, paleolith from Newcomerstown, Ohio; larger figure do from Amiens, France; both one-half size. From G. F. Wright's Man and the Glacial Period.

that he intentionally deceived Professor Wright in this matter, be produced; and the authority for the statement that such an assertion was made, should make himself known.. The image cannot well be the work of any existing Indian tribe, as has been asserted. In any case it seems that the evidence for Plistocene man in America, must be further investigated with careful methods, and under more favorable circumstances than are furnished by most of the so-called glacial gravels.

We give figures of two characteristic types of paleoliths; one of argillite found by Abbott at Trenton, N. J.; and one flint from Newcomerstown, Ohio. E. D. COPE.

Some Recent Books on Bacteriology.—One of the most recent works dealing with the bacteria is Dr. Sternberg's[1] Manual of Bacteriology. He is well known as an investigator in this field, and is moreover one of the pioneers in the United States. The work is a most comprehensive one, the best published in the English language. While perhaps not so full on pathogenic organisms as Baumgarten's Lehrbuch der Pathologischen Mycologie, yet it is sufficiently full and complete to make it one of the best books of its kind. It moreover contains accounts of the most recent discoveries in regard to pathogenic organisms.

One hundred and one pages are devoted to history, classification, morphology and general bacteriological technology. The author adopts the classification of Baumgarten (1890) with slight modifications. He divides the species into (1) relatively monomorphous and (2) pleomorphous. Under the first micrococci, bacilli, and spirilla are grouped; under the second spirulina of Hueppe, leptotricheæ (Zopf) and cladotricheæ. Hauser's Proteus also belongs here. Part second is devoted to general biological characters; including an account of the action of antiseptics and germicides. Dr. Sternberg's work on antiseptics and germicides is so well known that it will not be necessary to refer to this part of the work at length. Three hundred pages are devoted to pathogenic bacteria, 158 species are carefully described, and many are illustrated. In some cases the colors of the growth when grown in different nutrient media are given. Botanists will be chiefly interested in the account given of the saprophytic bacteria. Chapters are devoted to the bacteria of the air and water, bacteria found in the stomach and intestinal canal, articles of food and soil, in which the usual methods of culture are given. Three hundred and thirty one species are described. This feature of the book makes it especially commendable. Those who have had occasion to use the classification of De Toni in Saccardo's Sylloge Fungorum or that of Crookshank in his Manual of Bacteriology have found the descriptions of the species far from satisfactory. The descriptions given by Sternberg are ample for the determination of the species.

The biological characters are very full. An excellent bacteriological diagnosis is a great aid in the determination of the species. A few errors have made their way into this part of the book. On page 758, *Bacillus citreus-cadaveris* is said to be motile, but turning to page where the species are described it is said to be non-motile. The e for *Bacillus fulvus*, which p. 758, is said to be motile, but on p. 629 scribed as non-motile. Notwithstanding that a few of these defects ır, this part will certainly be appreciated by working bacteriolo-s. In this key the following characters are used. (1) Morphologic; rococci, Bacilli, Spirilla, Leptotricheæ and Cladotricheæ. Forma- of spores, independent motion. (2) Physiological characters; tion to oxygen, ærobic, strictly anærobic, facultative anærobic, wth in gelatin, liquefy or do not, no growth in gelatin, growth on ıto, in milk, coagulate milk, do not coagulate milk, color of growth, omogenes, not chromogenic, pathogenesis.

---

[1] A Manual of Bacteriology. Illustrated by heliotype and chromolithographic plates and two hundred and sixty-eight engravings, 886 pp. New York, Wm. Wood and Co., 1892.

he bibliography has been gotten together with great care, and is full, containing the titles of 2,582 papers grouped under historical sification, staining methods, culture media, sterilization of culture lia, etc. A very large number of papers are cited on the physiolog- properties, such as lactic acid fermentation, viscous fermentation, refaction, etc. The literature on pathogenic microorganisms is ecially full. Bacteriologists should feel grateful to Dr. Sternberg this work, and also to the publishers for the excellent manner in ch their part also has been performed.

Vm. Wood & Co. have during the past four years issued two other t books on bacteriology; the English translation of Salomonsen's cteriological Technology, by Professor Trelease is well known and ds no introduction. A second admirable work, antedating Stern-g's Manual, is Fränkel's Grundriss der Bakterienkunde translated J. H. Linsley.[2] It has been translated into six different languages, l those who have been fortunate enough to use the German edition ow its admirable qualities. The translation before us is an admir-e one. The style is clear and there is no difficulty in understanding author. The work contains a great deal on the biology of many cies that hitherto has not been found its way into English works. s to be regretted however that references to literature are not given, these may readily be obtained from Sternberg's Manual. No ıres are given in the book, but the accounts are clear. Future tions should have figures.

For a limited amount of work both of the books noticed above are large. One of the best of the small books with which the writer is niliar is Abbott's[3] Principles of Bacteriology.

Text-book of Bacteriology, third edition, translated and edited by J. H. Linsley, 376. New York, Wm. Wood & Co., 1891.

The Principles of Bacteriology. A manual for students and physicians. Lea thers & Co., Philadelphia, 1892, pp. 263

This book is well suited for class room work. Its technique is stated in clear and concise language, accompanied with numerous illustrations. The writer having used this for a large class is prepared to say that it is an excellent work of its kind.

Another hand-book intended for a larger circle of readers is Woodhead's[4] small volume on Bacteria and their Products. It treats the subject in a somewhat different manner than the others. It gives considerable attention to historical matters, and treats quite fully the different systems of classification used by Ehrenberg, Cohn, Van Tiegham, Zopf, De Bary, Hueppe and Flügge. The chapter on fermentations contains a great deal on chemistry, but it is far from being a popular exposition of the question. The author has of course largely drawn from Hansen, Pasteur, and Schützenberger. The author uses the word parasite and saprophyte in a somewhat peculiar way. He speaks of the bacteria of the mouth as being parasites, contradicting a previous statement made with reference to parasitic bacteria. The work has been edited rather carelessly, the word "parasiticism" for parasitism occurs in several places as well as the word "saprophyticism."—L. H. PAMMEL.

Report on the Fish and Fisheries of the United States for 1888.[5]—This volume, an octavo of 902 pages, contains in addition to the Reports of the Commissioner, Hon. Marshall McDonald and his two assistants, 11 important papers bearing upon the Fish Industry. The results of the sea-coast inquiries conducted during the year 1888 are embodied in the reports of Mr. J. W. Collins and Lieutenant Commander S. L. Tanner. The work accomplished at the laboratory of Woods Holl, Massachusetts is reported on by Mr. J. A. Ryder. Notes on Entozoa of Marine Fishes, with descriptions of new species and the anatomy of *Thysanocephalum crispum* Linton are given by Mr. E. Linton.

Number 8 in the series of Appendices is a review of the Fresh-water Sunfishes of North America by Mr. C. H. Bollman. It is the beginning of the systematic investigation of interior waters by volunteer naturalists under the direction of Dr. D. S. Jordan. The Apodal Fishes inhabiting the waters of America and Europe are reviewed by rdan and Mr. B. M. Davies. The work undertaken by Prof. Atwater ten years ago, viz., a comprehensive series of experi- upon the chemical composition and nutritive values of the can food-fishes, has been completed, and his report upon the sub- published as Appendix 10 to this volume. The last paper is J. llins' Report upon the participation of the U. S. Fish Commission Centennial Exposition held at Cincinnati, Ohio, in 1888.

---

[4] Bacteria and their Products. The contemporary Science series, edited by Havelock Ellis, pp. 459, with 20 photo-micographs. London, Walter Scott, 24 Warwick Lane, Charles Scribner Sons, New York, 1892.

[5] U. S. Commission of Fish and Fisheries. Part XVI. Report of the commissioner for 1888. Washington, 1892.

numerous illustrations and maps give additional interest to this ehensive report.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Oneonta and Chemung Formations in Eastern Central New York.—The Oneonta formation comprises a thick mass of red shales and red and gray sandstones, similar in character to the rocks of the Catskill Mountains. They overlie the Chemung formation in southern New York and northern Pennsylvania. The recent investigations of Mr. N. H. Darton confirm Professor Hall's supposition that the Oneonta beds represent the eastern extension of the Portage formation. The former is characterized by a large quantity of red shale which occurs as streaks in the lower beds, a thick mass a little higher in the series, and constitutes elongated lenses in the gray flags and red sandstones of the upper member of the formation. Toward the western termination of the Oneonta formation the red material rapidly disappears and its place is taken by gray shales and thin bedded sandstone. There can be no doubt of the continuity of sedimentation throughout. Toward the east the formation increases in thickness until it comprises the lower thousand feet of beds in the Catskill Mountains. The Chemung fossiliferous shales which overlie the Oneonta formation south of Franklin grade upward through a series of flags into hard, coarse, cross-bedded gray sandstones with intercalated red shale layers. Toward the east the fossiliferous shales merge into flags, and then into hard, coarse sandstone with flaggy layers along the eastern front of the Catskill Mountains.

Since the rocks of the Catskill Mountains comprise the Chemung and Portage horizons, Mr. Darton proposes to discard the use of Catskill to designate a formation, and to use the term Catskill group to include the Chemung and Portage formations. (Am. Journ. Science, March, 1893.)

Tertiary Insects from Colorado and Utah.—Bulletin No. 93 of the Geological Survey comprises descriptions of eight species of Oligocene insects from Florissant and other points in Colorado and Utah, by Samuel H. Scudder.

Of this group of interesting fossils six are referred to new genera. In a short introduction the author gives the special claim which each s for consideration. The Trichocemsis represents a type hitherto nsidered exclusively gerontogeic; the Stenogomphus is the first omphine fossil found in this country; the Cicada for its great size d for being the first member of its family known from American cks; the Hymenoptera is curiously related to Oriental forms; the iptera are interesting departures from the modern types to which ey are most nearly allied; the two Coleoptera present some curious atures; the butterfly is of exceptional interest as belonging to a aning type which probably flourished remarkably in Oligocene times, the published figures are to be regarded as having any weight at all.

A Supposed New Order of Gigantic Fossils from ebraska.—In "University Studies," published by the University of ebraska, 1893, Mr. E. H. Barbour describes and figures a number of gantic mineral bodies of such anomalous form and structure, that the thor offers as a merely provisional classification until their place can more definitely determined.

These fossils are found in the Miocene beds which follow the divide tween the White and Niobrara rivers in Sioux County, Nebraska. hey are very abundant and increase in size toward the southern limit the beds. In appearance they resemble colossal corkscrews varying om two to nine feet in length. A transverse piece corresponding the handle of the corkscrew, for which the term rhizome is adopted the author, is often three feet in diameter. The fossil corkscrew invariably vertical, while the so-called rhizome as invariably curves pidly upward and extends outward an indefinite distance. Some of e screws coil about an axis, others are unsupported. The author is ositive as to their organic origin, and is inclined to believe them to be onges. Five microscopic slides show certain smooth spindle-shaped ds suggestive of sponge spicules, but a sixth section reveals unmiskable plant cells. A third evidence of their organic nature is the aracteristic intricate network of minute silicious tubes in the stems. o add to the difficulty of the problem, a well-preserved skeleton of a dent was found in the great stem of one specimen. This rodent is e size of a "jack rabbit," with proportionately large incisors, sagittal d occipital crests high and sharp, and a mole-like shoulder girdle.

In order to preserve the appropriate name—"Devil's Corkscrew"—estowed by the ranchmen, Mr. Barbour calls these strange fossil forms aimonelix.

The most probable explanation of these objects seems to be that they re the casts of the burrows of some large rodent. The horizontal poron will then be the entrance; the enlargements the position of the

nests, and the spiral vertical portions shafts for safety or escape of
occupants, or for the admission of air; the spiral being necessary
the convenient ascent of the animal. It is well known that specie
Thomomys make spiral burrows; and remains of this genus are
rare in the Plistocene beds of Kansas.—C.

Mammalia from the "Pits of Gargas."—In the grotto
Gargas, not far from Montréjean, a number of pits have been fo
about 100 metres from the entrance. These pits are 20 metre
depth and have mouths so narrow that it is with difficulty that a n
can force himself through the openings. M. Regnault has recen
explored these pits and found them rich in fossil remains of be
(*Ursus spelæus*, the small variety), wolves (*Canis lupus*), and hyae
(*Hyaena crocuta*). M. Gaudry notes the unusual circumstance of
fine state of preservation of the fossils, particularly of a hyaena an
wolf, of which almost complete skeletons were obtained. These fi
have been made the subject of a joint paper by MM. Gaudry and Bo
in which they discuss the affinities of these cave animals, and g
tabular statements of the genealogy of the bears and of the hyaen
The latter differs from the one published by Schlosser in 1890.

A series of fine plates illustrates the paper. (Materiaux Po
l' Histoire des Temps Quaternaires. Quatrième Fascicle, Paris, 189

Mr. G. F. Matthew reports a new genus, Protolemus, of Trilobi
from the St. John group of the lower Cambrian beds. The new ge
is represented by two species, *P. elegans* and *P. parodoxoides*. (B
New Brunswick Nat. Hist. Soc., 1892.)

The Cleveland shale of Ohio has yielded a new Coccostean, whic
described by Professor Claypole under the specific name *Coccost*
cuyahogae. This species comes from a higher horizon than either
hercynius or *C. occidentalis*, and is remarkable for its large size. (A
Geol., March, 1893).

Paleozoic.—Mr. H. E. Sauvage has been studying the fish fa
of the Permian of France. He finds that of 24 species, 14 are, for
present, peculiar to France. This fauna is, undoubtedly, that of
Lower Permian, and is characterized by a predominance of spe
belonging to the genera Amblypterus. (Revue Scientifique, Av
1893.)

Mesozoic.—According to Chapman, the Phosphatic Chalk
Taplow, England, has yielded 5 species and varieties of Ostracoda,
previously known, and 98 species and varieties of Foraminifera,
which the following are new to science: *Nubecularia jonesiana*, *Tex*

laria decurrens, *Textularia serrata*, *Bulimina trigona*, and *Bolivina strigillata*. (Quart. Journ. Geol. Soc., Nov., 1892).

Cenozoic.—The Pliocene fauna of Rousillon, which now numbers over 30 species of vertebrata, has recently had a second Proboscidian, *Mastodon borsonii*, added to the list of mammalia. The specimen, found near Villeneuve-de-Raho, consists of the series of upper molars, a tusk, and a part of the right occipital region. This discovery is important, as it gives a wide geographical range to *M. borsonii*, which has not before been known from any pliocene bed of southern France. (Revue Scientifique, Mars, 1893.)

Dr. Noetling, in a report on Jade in Upper Burmah, says that jade is found in association with and enclosed in an eruptive rock closely resembling serpentine, and that this serpentine pierces strata of perhaps lower, but more probably Upper Miocene date. The jade found in Burmah belongs to a group of eruptive rocks of late Tertiary age. (Nat. Sci., April, 1893.)

The prevalence of lake basins in glaciated countries is accounted for by Mr. J. C. Hawkshaw by the following conditions:

Earth movements in limited areas tend to form basins; these movements are gradual, and, under ordinary circumstances, the basins are obliterated by water-borne detritus, growth of vegetation and erosion. In glaciated regions the basins are not only protected by the ice from such destructive action, but they are still further deepened by its grinding action. (Nature, April 13, 1893.)

M. M. Boule has described and figured the *Hyaena brevirostris* found by M. Aymard in the Pliocene deposits of Sainzelles near Puy (Haute Loire). Although this fossil has been referred to by Pomel, Gervais, Gaudry and Weithofer, no detailed description of it accompanied by figures has ever before been given. (Ann. Sci. Nat. Zool. t. XV, 1893.)

According to Mr. R. T. Hill, the Hematite and Martite iron ores of Mexico occur in the Cretaceous and Tertiary rocks, and are undoubtedly of later age than the rocks in which they occur. This is an unusual geologic age for ore. (Am. Journ. Sci., Feb., 1893.)

Mr. Warren gives, as a result of a comparison between pleistocene and present ice-sheets, an opinion that the Ice Age was a continuous and geologically brief period. (Bull. Geol. Soc. Am., Vol. IV, 1893.)

Mr. E. T. Dumble reports the occurrence of Grahamite in two localities in Texas. The first specimen came from the Fayette beds in Webb County, the second from the lowest strata of the Eocene exposed on the Rio Grande River in Fayette County. (Trans. Am. Inst. Mine Engineers, 1892.)

MINERALOGY AND PETROGRAPHY.[1]

The Petrography of the Abukuma Plateau, Japan.—The northern half of the Japanese Archean area, the Abukuma Plateau, is thought by Koto[2] to consist of a series of Laurentian granites and pressure gneisses, cut by younger granites and other eruptives, and overlying these a series of schists, divided by the author into lower and upper Huronian. The Laurentian granitic are an older amphibole-biotite variety and a younger, intruding biotite granite. The former contains, in addition to the usual granite components, microcline, and a bluish-green, weakly pleochroic hornblende, that very frequently plays the *role* of an ophitic groundmass for the other constituents. This granite passes by dynamo-metamorphism into foliated phases, in which the various minerals have been compressed, and the quartz, in addition, granulated. The Huronian (?) beds are principally schists and gneisses, that differ from the Laurentian gneisses in having the plane parallel structure, i. e., they are composed of bands of different composition. The most important schists of the lower division are: gneissic mica schists, containing andalusite and sillimanite, two-mica schists, one of whose constituents is margarite, garnet-biotite schist and hornblende schist. A peculiar member of the series is a titanite amphibole schist, consisting of bands whose structure is granular. Its black bands are made up of green-hornblende, plagioclase and a little biotite, and its white ones of sphene and granular sahlite in a groundmass of altered feldspar. The upper Huronian series embraces foliated amphibolites, mica-schists, and green schists that may be tufas. The distinction between the lower and upper members of the group seems to be based mainly upon petrographical characteristics. Among the rocks cutting these various schists may be mentioned an amphibole-picrite, pegmatites, and several varieties of diorite-porphyrite.

The Leucite-Tephrite of Hussak, from New Jersey.—The eleolite syenite eruption of Beemerville, N. J., was accompanied by basic extrusions now represented by the smaller dykes associated with the large eleolite-syenite dyke in this region. One of the most interesting of the basic dykes is the one at Hamburg, Sussex Co. It is from 15 to 20 feet wide and consists of a dark, tough, biotite rock, holding

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Jour. Coll. Science, Imperial University, Japan, v, 3., p. 197.

roidal inclusions, that have been taken for Hussak[3] to be leucites.
p[4] has recently examined this rock very carefully, and now
ibes it as composed of biotite and pyroxene imbedded in an iso-
c groundmass that is chiefly analcite. The biotite is dark brown
the pyroxene of a faint yellow color, with an extinction of 33°.
spheroidal inclusions are analcites, about whose ruins are often
ped grains of biotite and crystals of sphene. An analysis of one
e spheroids, after deducting 3.886 % of Ca Co$_2$, gave:

H_2O	SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O
6.31	52.44	26.44	.43	1.94	3.54	8.90

o the origin of the analcite the author is not certain. It may
been derived either from leucite, in which case the rock would be
icite-tephrite, as considered by Hussak, or it may be alteration
uct of nepheline.

Sodalite-Syenite from Montana.—In the mountains form-
he northern portion of Montana, Lindgren[5] and Melville have dis-
ed post-cretaceous quartz-porphyrites, lamprophyres, augite-
ytes, analcite basalts, and a peculiar sodalite-syenite, somewhat
bling certain rocks described by Chrustschoff from Russia. The
tana syenite is from Square Butte, situated thirty miles southeast
ort Benton. It is a light gray eruptive, associated with sheets of
lite and analcite basalt. Macroscopically it consists of lath-
ed feldspars, prisms of hornblende and pale brown grains of soda-
In addition, analcite and plagioclase are discoverable under the
oscope. Many of the feldspar crystals are corroded in an extraor-
ry manner and the cavities thus formed in them are filled with
ite which is believed to be an alteration product of albite. The
blende is very dark brown, almost opaque, with a strong pleo-
sm, an extinction of 13° and a density of 3.437. Its analysis
ates its identity with the variety barkevikite:[6]

SiO_2	$Al_2O_3(TiO_2)$	Fe_2O_3	FeO	NiO	MnO	CaO	MgO	Na_2O	K_2O
38.41	17.65	3.75	21.75	tr	.15	10.52	2.54	2.95	1.95

sodalite is quite fresh. It forms irregular grains that are bounded
rystal faces when in contact with analcite. It was evidently
ed after the feldspar but before the analcite. The composition of

---

MERICAN NATURALIST., March, 1893, p. 274.
mer. Journ. Sci., Apr., 1893, p. 298.
mer. Journ. Sci., June, 1893, p. 286.
MERICAN NATURALIST, June, 1890, p. 576.

the rock as calculated from its analysis is: 23% hornblende, 50% orthoclase, 16% albite, 8% sodalite, and 3% analcite.

The Anorthosites of Canada.—The Canadian geologists have long considered the Laurentian of northern North America as consisting of an upper and a lower division, of which the latter rests unconformably upon the former. This upper division is made up largely of basic schists to which the name Novian was given by Hunt. Adams[7] has examined all of the important occurrences of the supposed schists, and has discovered that in all cases they show an irruptive contact with the surrounding gneisses, which they evidently cut. They are thus unquestionably post-Laurentian, and, from their relations to the overlying rocks, they are thought to be pre-Cambrian. The dark rocks are anorthosites—aggregates of plagioclase, with a little pyroxene, olivine and some accessories—which are in places schistose, and in other places are connected genetically with gabbros. The schistosity of the rock is accompanied by the possession of cataclastic structure, regarded by the author as due not to dynamic processes, but to the movement of the magma just before final consolidation. The plagioclase of the rock which is by far its most prominent component, is a labradorite so filled with tiny inclusions of microlites, thought by the author to be ilmenite tables, that fragments of the mineral are dark and often show the play of colors so beautifully seen in the labradorite of Labrador. The pyroxenes are a weakly pleochroic green augite, and a strongly pleochroic hypersthene. Hornblende, biotite, quartz, garnet and zircon are also present in small quantities in all specimens of the anorthosite. In the Saguenay river occurrence, olivine is enclosed in the plagioclase, and between it and the latter mineral is a reaction rim, composed of an inner zone of hypersthene, and an outer one of actinolite, including many small, green spinels. All the occurrences of the rock in Canada are briefly described, and with them are compared similar occurrences found elsewhere.

The Melibocus "Massiv" and its Dyke Rocks.—The peak of Melibocus[8] in the Odenwald consists mainly of a medium-grained white granite to the West, and a complex of schists and gneisses to the East. The granitic constituents, orthoclase and quartz, are usually aggregates of small grains variously orientated, and the biotite shows evidence of having been subjected to pressure. Near the contact with the surrounding rocks the granite becomes gneissic, and everywhere it is cut by dykes of aplites, porphyries and lamprophyres. Where the aptites penetrate the gneisses they possess the usual characteristics of these rocks, but where they pass from the schists into the granite they become porphyritic, showing a fine grained groundmass of quartz, orthoclase and mica and numerous phenocrysts of the same minerals and garnet. Like the granite the aplite components exhibit evidences of the effect of pressure. The large crystals are granulated and the rock's structure is more or less schistose. For this aplitic rock with porphyritic crystals the author, Chelius, used the name Alsbachite. An analysis of an alsbachite from the northwest side of the mountain gave:

---

[7] Neues Jahrb. f. Min., etc., B. B. viii, p. 419.

[8] C. Chelius: Notizbl. d. Ver. f. Erdk. z. Darmstadt, 1892, iv, F. 13 H., p. 1.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
74.13	12.61	2.87	.86	.16	1.60	.23	2.13	4.55	.66

The dioritic aplites, malchite, luciite and orbite are also represented among these dyke rocks—the malchite being the panidiomorphic diorite aplite, the luciite the hypidiomorphic granular forms, and the orbite the corresponding porphyritic phases. One of the luciites is described as made up almost exclusively of plagioclase and hornblende. Among the lamprophyric dykes, mention is made of a gabbrophyre, or odinite, which differs from the gabbro-aplite, beerbachite, in consisting of phenocrysts of plagioclase and colorless augite in a matrix of plagioclase laths and hornblende needles, while the aplite is a panidiomorphic aggregate of diallage and feldspar, with the addition, sometimes, of hornblende crystals that enclose the other constituents. The descriptions of all these rare rocks are very brief.

The Granites of Argentina, S. A.—In an elaborate description of 185 hand specimens of stock and dyke granites and pegmatites, cutting the archean and paleozoic beds of Argentina, and of younger granites cutting these older ones, Romberg[9] discusses at some length the origin of the micropegmatitic intergrowth of quartz and feldspar. He believes that in the rocks studied by him the quartz in the intergrowths is secondary, and that it has originated in the decomposition of orthoclase and plagioclase. Many micro-photographs accompanying the author's article illustrate clearly the steps by which this conclusion was reached. Although the description of the specimens is exhaustive, it contains no points of special interest. At the conclusion of the paper is a list of the specimens examined, with their localities, and appended to it are twelve plates containing seventy-two micro-photographic reproductions of their sections.

---

[9] Neues Jahrb. J. Min., etc. B. B. viii, p. 275.

New Minerals.—*Geikielite.*[10]—This mineral was found as pebbles in the gem washings near Rakwana, Ceylon. It is essentially a magnesium titanate, $MgTiO_3$, corresponding to the calcium compound, perofskite. The mineral is bluish-black and opaque, with a brilliant lustre, and possessing two cleavages at right angles to each other. Its density is 3.98 and hardness 6.5. In thin section it is translucent with a purplish-red tint, and in converged light it shows a uniaxial figure.

Baddeleyite,[10] also occurring as pebbles in the above-mentioned locality, is a black substance with a density of 6.02 and a hardness of 6.5, thus strongly resembling columbite. Under the microscope small fragments are seen to be dichroic in greenish-yellow and brown tints, and to possess a biaxial symmetry. The crystallization is thought to be monoclinic, though only a few plans could be detected on the specimen. In chemical composition the substance is zirconia ZrO_2.

Folgerite, *blueite* and *whartonite* are all nickel-iron-sulphides from the Sudbury nickel mines at Algoma, Ontario. Emmens[11] describes the first named as a massive, bronze-yellow substance, with a grayish-black streak, a density of 4.73 and hardness 3.5. Its composition ($Fe = 33.70$; $Ni = 35.20$; $S = 31.10$) corresponds to $Ni\,Fe\,S_2$.

The *blueite* is also massive. Its color 'is olive-gray or bronze; its streak black, density 4.2 and hardness 3–3.5. Its analysis yielded $Fe = 41.01$; $Ni = 3.70$; $S = 55.29$, corresponding to pyrite with a thirteenth of the Fe replaced by Ni. Unlike pyrite, however, it dissolves easily in nitric acid, without the precipitation of sulphur.

Whartonite differs from blueite in containing more Ni. Its composition is $Fe = 41.44$; $Ni = 6.27$; $S = 52.29$, corresponding to $(Fe\,Ni)\,S_2$ in which $Fe : Ni = 7 : 1$. Its hardness is 4, density 3.73, and color and streak like those of blueite.

Hauchecornite is another nickel mineral. It is described by Scheibe[12] from the Friederich mine in the Hamm mining district, Germany. It is found in bronze-yellow tetragonal crystals, with a hardness of 5, and a density of 6.4. It is thought to have the composition corresponding to the formula $Ni\,(Bi.\,Sb.\,S)$, though analysis yields discordant results.

Cuprocassiterite was described by Ulke[13] from the Etta mine, South

---

[10] Fletcher: Nature, Oct. 27, 1892, p. 620.

[11] Jour. Amer. Chem. Soc., Vol. xiv, No. 7.

[12] Jahrb. A. preuss. geol. Landeranst, 1891, p. 91.

[13] Proc. Amer. Inst. Min. Engineers, Feb. 1892.

Dakota, but the author's data were so scanty that Headdon[14] has thought it advisable to add a small additional contribution to the literature of the mineral. This last-named writer obtained a small quantity of what he supposed to be Ulke's new mineral from both the Etta and Peerless mines, and found upon examination that in the interior of a small mass from the Peerless mine is a nucleus of stannite containing a little cadmium. Intergrown with this and also forming an envelope around it is a green clayey substance, which, upon its exterior, passes into a yellow earth. The green substance has a density of 3.312–3.374. Its analysis shows it to be a mixture of about 7 SnO_2, 6 CuO, 2 FeO and 11 H_2O. The author regards it is an alteration product of stannite, but not as a well-defined mineral species.

New Edition of Rosenbusch's Volume on Minerals.—The new edition of Professor Rosenbusch's[15] Microscopic Physiography of the Rock-forming Minerals is an enlargement rather than a revision of the second edition. There is no material difference in the arrangement of the matter in the two editions, but there have been large additions made in the later volume in the shape of descriptions of new petrographical apparatus and methods, and in the number of minerals treated. The plates illustrating the text have been decreased by one. The remainder are much better executed than was the case in the earlier volume.

Mineral Syntheses.—Michel[16] has obtained *melanite* garnets and *sphene* crystals by cooling slowly a mixture of 10 parts titanic iron, 10 parts calcium sulphide, 8 parts silica and 2 parts carbon, that had been heated to 1200° for five hours.

Crystallized *leucite*, *potassium cryolite* and *potassium nepheline* results from the fusion of silica or of fluosilicate of potassium and alumina with an excess of fluoride of potassium. Prolonged heating produces leucite, and potassium cryolite. Less prolonged treatment yields a potassium nepheline, which crystallizes in negative orthorhombic prisms.[17].

Instruments.—For measuring the curves of isotherms on mineral plates Jannetaz[18] has constructed a new ellipsometer, which it is believed will enable its user to measure accurately the axes of the isothermal ellipses, and to determine rapidly in each case whether apparently circular isotherms are in reality circles or slightly eccentric ellipses.

---

[14] Amer. Jour. Sci., Feb., 1893, p. 105.

[15] H. Rosenbusch: Mikroskopische Physiographie der petrographisch wichtigen Mineralien, Stuttgart, 1892, pp. 712, Fig. 239, etc.

[16] Comptes Rendus, Vol. cxv, p. 830.

[17] Duboin, Bull. Soc. Franc. d. Minn., Vol. xv, p. 191.

[18] Bull. Soc. Franc. d. Minn., Vol. xv, p. 237.

A new machine for cutting and grinding thin sections of rocks and minerals, with stored electricity as the motive power, is described by G. H. Williams[19].

Rock Separations.—Thallium-silver-nitrate [$Tl\ Ag\ (NO_3)_2$], according to Retgers,[20] is an excellent medium for the separation of mineral grains of great density. The double salt fuses at 75°, and in the fused condition is clear and mobile. In this condition its specific gravity is 5, and this may easily be lowered by the addition of water. Its manipulation is simple. A small beaker containing the solid salt is placed in a water bath and heated. Upon its liquefaction the powder to be separated is added and the mixture is allowed to stand for a short time. As soon as a layer of clear liquid forms between the precipitated and the floating grains the beaker is plunged into cold water. The salt thus consolidates rapidly. The beaker is now broken and the heavy grains are collected by scraping and washing.

A new method of separating the constituents of rock powders, whose densities are above 2.60, has been devised by Dafert and Derby.[21] The principle involved is the suspension of small particles in gentle currents of water. The apparatus necessary for the operation is fully described by the authors. Separation is not complete between powders of nearly the same density, but there is a strong concentration of the heavier and the lighter ingredients in the two resulting portions of the separated material.

---

[19] Amer. Jour. Sci., Feb. 1893, p. 102.

[20] Neues Jahrb. f. Min., etc., 1893, Vol. I, p. 90.

[21] Proc. Roch. Acad. Sci., Vol. II, p. 122.

BOTANY.

æoma nitens.—The development of *Cæoma nitens* has recently studied by Mr. H. M. Richards, and the results published in an esting paper in the Proceedings of the American Academy of and Sciences. The particular question investigated was whether ot the spermogonia are developed within the cavities of the ermal cells of the host. By means of carefully made sections, Mr. ards demonstrates that they arise as masses of hyphæ which push *etween* the epidermal cells, and that later the walls of some of these become absorbed. The spermogonia are therefore at first inter- lar, but by the absorption of the walls they become intracellular.

CHARLES E. BESSEY.

ur Naiads.—Thomas Morong's monograph "The Naiadaceæ of h America" has been brought out in the *Memoirs of the Torrey nical Club.* It contains descriptions and plates of 54 species ributed as follows: *Triglochin,* 3 species; *Scheuchzeria,* 1; *Lilæa,* *Potamogeton,* 37; *Ruppia,* 2; *Zannichellia,* 1; *Naias,* 4; *Zostera,* *Phyllospadix,* 2. Among these we find one new species *Potamoge- faxoni* from Lake Champlain, and several new varieties of pre- sly described species. Quite a number of changes have been made e nomenclature of the species.

hus comparing Dr. Morong's list with that in the 6th edition of y's "Manual," we note the following changes: *Potamogeton penn- nicus* Cham. and Sch. becomes *P. nuttallii* Cham. and Sch., since latter was described on an earlier page of *Linnæa* than the former 1827); *P. hybridus* Mx. (1803) being preoccupied (by Thuillier 790), gives way to *P. diversifolius* Raf. (1808); *P. rufescens* Schrad. 5) is antedated by *P. alpinus* Balbis (1804); *P. fluitans* Roth. 8), gives way to *P. lonchites* Tuck. (1848), inasmuch as it is ly improbable that the European and American species are tical; *P. zizii* Mert. and Koch. of the "Manual" appears to have uded two species which are now to be known as *P. spathulæformis* bbins) Morong, (*P. gramineus,* var. (?) *spathulæformis* Robbins, *P. hæformis* Tuck., and *P. varians* Morong), and *P. angustifolius* ch. and Presl. (*P. lucens,* var. *minor* Nolte); the var. *lanceolatus* bins (1867) of *P. perfoliatus L.* being preoccupied by Blytt (1861) t give way to var. *richardsonii* Ar. Bennett (1889); *P. pauciflorus* sh. (1814) must be replaced by *P. foliosus* Raf. (1808); *P. mucron-*

atus Schrader, being uncertain, the species is to bear the name of *P. major* (Fries) Morong; *P. tuckermani* Robbins (1856) gives way to the earlier *P. confervoides* Reichb.; *P. marinus* L. turns out not to be that species, and must take the name *P. filiformis* Pers. (1805).

CHARLES E. BESSEY.

Hough's American Woods.—The third part of R. B. Hough's "American Woods" has recently been distributed. The twenty-five species in this part are *Magnolia glauca, Ilex opaca, Acer rubrum, A. negundo, Prunus pennsylvanica, P. avium, Pyrus communis, Cratœgus punctata, Amelanchier canadensis, Liquidamber, styraciflua, Diospyros virginiana, Fraxinus sambucifolia, Morus rubra, Hicoria sulcata* (*Carya sulcata*), *H. glabra* (*Carya porcina*), *Quercus bicolor, Q. prinus, Q. muhlenbergii, Q. coccinea, Betula populifolia, Salix amygdaloides, Populus tremuloides, P. dilatata, Chamœcyparis thyoides, Pinus mitis.*

Each species is represented by three sections of the wood, transverse, radial and tangential, each 4½ by 2 inches. A good descriptive text accompanies the set of specimens. The parts are sold by the author at Lowville, N. Y., for the low price of five dollars each.

CHARLES E. BESSEY.

Allen's Characeæ of America.—Five years ago Dr. T. F. Allen of New York City brought out Part I of a promising work on the Characeæ of America, consisting of an introductory chapter on the structure, followed by the keys to the species of all our genera. He has now brought out the first fascicle of Part II in which he begins the work of carefully describing and illustrating every species. The illustrations are ample, there being no less than fourteen plates for the eight species of *Nitella* included. The descriptions are full and apparently well drawn up, measurements being fully given. The following are the species described:

N. opaca Ag.—New England and Canada to California and Mexico.

N. obtusa Allen.—A new species from Lake Tamisconata, Canada.

N. montana Allen.—A new species from Montana.

N. blankinshipii Allen.—A new species from Missouri.

N. missouriensis Allen.—A new species from Missouri.

N. flexilis Ag.—Across the continent.

N. subglomerata A. Br.—N. Y. and N. J. to Oregon, Texas and Missouri and the var. *brachyteles* A. Br. of this species occurs in Mexico Alabama.

N. glomerulifera A. Br.—Mass. to N. J., Ohio and Louisiana.

Every botanist will hope for the early appearance of the succeeding fascicles. CHARLES E. BESSEY.

ZOOLOGY.

A Medusa from Lake Tanganyika.—In the "Annals of Natural History," for the present month, will be found an account of a very interesting zoological novelty. Mr. R. T. Günther describes and figures a remarkable new form of Medusa, or jelly-fish, that occurs in Lake Tanganyika. Until recent years, when the little Limnocodium was found living in the Victoria lily-tank of the Botanic Gardens, Regents Park, it was believed that the Medusæ were nearly exclusively oceanic. It is now shown that the freshwater lake Tanganyika is the home of a peculiar member of this group. The existence of such an organism in Tanganyika was asserted some years ago by the German naturalist, Dr. Boehm, and Professor v. Martens, of Berlin, even went so far as to name it Tanganjicæ, although he had never seen a specimen. Mr. Günther now supplies us with a full description of this singular Hydrozoon, which he refers to a new genus, Limnocnida, adopting the suggestion of v. Martens as to its specific name. *Limnocnida tanganjicæ* is, as might have been anticipated, perfectly different from all the members of the group hitherto known, and probably represents a distinct family, but its exact position cannot be settled positively until the mode of its development has been ascertained. (Nature, April 13, 1893.)

The Air-Bladder and Weberian Ossicles in the Siluroid Fishes.—A study of the physiology of the Weberian ossicles and of the air-bladder in general has been made by Professors T. W. Bridge and A. C. Haddon, for the purpose of discovering the physiological relation of the Weberian mechanism to one of the several functions that have been ascribed to the auditory organ or to the air-bladder. With this object in view they discuss (I) how far the function of the Weberian mechanism is conditioned by the anatomical structure of the air-bladder and auditory organs as well as by the character of the mechanism itself; (II) to which of the known functions of the air-bladder and auditory organ the Weberian ossicles are to be regarded as accessory structures; and (III) the utility of the mechanism to the fish possessing it.

The authors find (I) that from the anatomical structure of the parts the Weberian apparatus is better adapted to register the more forcible distentions or contractions of the anterior chamber of the air-bladder rather than the slight or rapidly recurring vibrations of its lateral walls. (II) The ossicles under consideration are accessory to the hydrostatic function of the air-bladder. (III) The Weberian mechanism is of great functional importance to the fish possessing it, since it confers on them an exceptional capacity for freedom of locomotion in a vertical direction. The possession of this mechanism permits all movements to be made with the maximum economy of muscular effort and tissue metabolism.

In regard to the evolution of the Weberian mechanism the authors reach the following tentative conclusions:

1. The special feature of a fresh-water habitat that has conditioned the development of the Weberian mechanism in the Ostariophyseæ is the occurrence of seasonal or periodic quantitative variations in the food supply, variations to which the Ostariophyseæ, from their herbivorous or omnivorous habits are specially liable. ;

2. In view of such unfavorable nutritive conditions, the special advantage which is conferred upon the Ostariophyseæ by the possession of the Weberian mechanism is a capacity for executing locomotor movements in any plane, with an almost irreducible minimum of muscular effort and tissue metabolism.

3. If a variable and inconstant food supply is to be regarded as one of the inevitable conditions of a fresh-water existence, and necessitates strict economy in the expenditure of muscular energy, any mechanism which secures this result must be of unquestionable importance to the species, and hence it may be that the Ostariophyseæ owe their dominant position among fresh-water fishes to the possession of the Weberian mechanism.

4. The evolution of the Weberian mechanism has not only conditioned the predominancy of the Ostariophyseæ, but, indirectly, has favored the existence in fresh water of a large number of purely carnivorous fishes, which depend on the former for their food, and therefore may also be regarded as one of the primary causes of the anomalous abundance and diversity of fresh-water piscine life, as compared with the remarkable poverty of all other groups of fresh-water organisms. (Proceeds. Roy. Soc. Vol. LII, 1892).

Age Modifications of the Mucous Lining of the Stomach of Ruminants.—In a study of the Comparative Anatomy of the Stomachs of Ruminants, Mr. J. A. Cordier has discovered the following interesting facts.

The interior of the stomach of a young adult is covered with papillæ closely packed, which are larger in the region which Wilkins calls the "col" of the paunch, than on the rest of the surface. In the stomach of a very old animal a different condition exists. The large papillæ of the "col" are few and far between—two or three times as far apart as in the younger animal, much smaller, twisted once on the base, evidently becoming atrophied. Between these papillæ can be seen traces of many others which have disappeared, leaving their bases only as vestiges, and these are entirely covered by the ordinary epithelium of the stomach.

That these papillæ do not renew themselves is shown by histological sections of the papillæ. In a bison, thirty years of age, the papillæ were almost entirely wanting. An antelope and a ram showed the process of degeneration very clearly.

The second age modification is the appearance of a black coloration more or less intense over the entire surface of the stomach. Observations so far, however, show that this modification takes place in domestic animals only. [Bull. Soc. Zool., T. XVII, 1892.]

Zoological News.—According to C. H. Eigenmann, the development of the Point Loma blind fish (*Typhlogobius californiensis* Steindachner), is a striking example of the degeneration of the eyes. The embryo, before it is hatched, has eyes developed as well as the embryo of any other fish. When the individuals have reached the length of an inch they can still see a short distance, but it is evident that the eye has stopped growing long before this age is reached. In the adult condition the eye has become degenerated and covered with a thick skin, and the fish is totally blind. (Proc. U. S. Natl. Mus., 1892.)

In his Comparative Notes on Swifts and Humming-Birds, Dr. Shufeldt submits 61 important structural differences existing between the *Cypseli* and the *Trochili*. These differences, in the author's opinion, establishes the fact that these two groups, morphologically speaking, are not related. (The Ibis, Jan., 1893).

A new rat, *Perognathus merriamii*, is described by J. A. Allen, from southeastern Texas. It is allied to *P. flavus*, but differs from it in coloration, in the general form of the skull, and in the relative size and proportions of special parts of the skull. The species is based on 17 specimens from Brownsville, Texas. (Bull. Am. Mus. Nat. Hist., 1892.)

Mr. Amos Butler reports that the "Least Shrew," *Blarina parva* (Say), the smallest mammal in the United States, is rather common in the Whitewater Valley in Indiana. (Proc. Indiana Acad. Science, 1891, p. 163, 1893.)

Mr. Witmer Stone notes the occurrence of the genus Neotoma in Pennsylvania. The specimens, which were secured near the top of South Mountain in Cumberland Co., evidently belong to a new species, and are described by Mr. Stone under the name *Neotoma pennsylvanica.* This species is distinguished from *N. floridana* by its larger size, its densely hairy and distinctly bicolored tail, and by certain well-marked cranial characters. (Proceeds. Phila. Acad., 1893.)

ENTOMOLOGY.[1]

North American Cosmetidæ—A recent study of a considerable collection of Cosmetidæ from the Southern States shows that three well-marked species occur in our fauna. This family belongs to the sub-order Mecostethi of Simon or Laniatores of Thorell, of the order Opileonea. Say described one species, Wood another and Sorensen the third. The three species are closely related and all belong to the genus Cynorta. They may be separated by the following key:

Posterior pair of abdominal tubercles very prominent; four or five times as large as anterior pair. . . . . . *C. ornata.*
Posterior pair of abdominal tubercles little larger than anterior pair.
  Dorsum with a distinct yellow Y connected posteriorly with a transverse yellow line. *C. albolineata.*
  Dorsum without or with very little yellow marking. *C. sayi.*

Cynorta ornata is abundant in Florida and probably occurs in the South Atlantic States; *C. albolineata* is found in Louisiana and Mississippi; and *C. sayi* in Texas. An illustrated descriptive synopsis of these species is now in the hands of the American Entomological Society for publication in the *Transactions.*—CLARENCE M. WEED.

An American species of Sabacon.—In 1879, the French Arachnologist, M. Eugene Simon established[2] the genus Sabacon for a very peculiar species (*S. paradoxus*) of the family Ischryopsalidæ—one of the smaller families of the Opileonea. The specimen described was immature and the lateral pores were not distinct. No other species of the genus appear to have since been described.

The genus Sabacon is especially characterized by the peculiar form of the palpi, the joints of which are large and swollen, and the short tarsus is not provided with a claw, but is capable of being turned back against a depression in the tibia. The mandibles are shorter than the body.

---

[1] Edited by Prof. C. M. Weed, New Hampshire College, Hanover, N. H.

[2] Arachnides de France, VII, 266.

During the autumn of 1892, I found under a piece of driftwood along a small creek, a fully developed male belonging to this genus. The species is evidently rare for I have never been able to find another although I have searched persistently.

Sabacon spinosus, n. sp.

Male.—Body 3 mm. long, 2 mm. wide; palpi, 3 mm. long. Legs: first, 11.5 mm.; second, 19 mm.; third, 12 mm.; fourth, 16.5 mm.—Body testaceous with dusky markings; the markings on dorsum arranged transversely and following segmentation. Palpi and legs light testaceous with almost continuous dusky blotches. Ocular tubercle black, very near front margin of cephalothorax, much wider than long, low, with a deep longitudinal sinus but no spines on carinæ. A small round, not very distinct pore on each cephalo-lateral angle of the dorsum, not isolated by distinct oblique sinuses. On the dorsum of the cephalothorax and the ocular tubercle are many short, acute, black spines arranged more or less irregularly; back of ocular tubercle on cephalothorax are two transverse rows of similar spines, and on

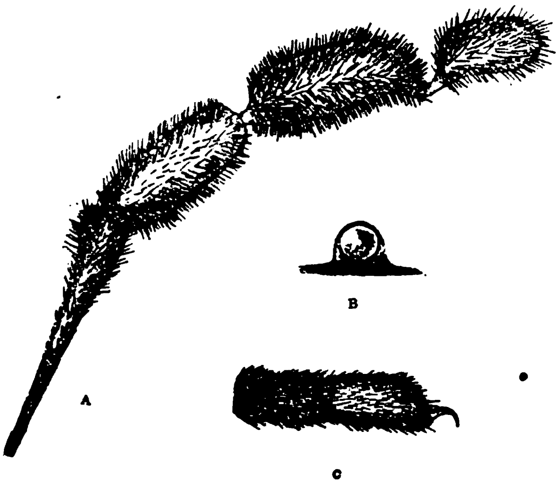


Fig. 1.—*Sabacon spinosus.* Male: *A*, palpus; *B*, eye eminence; *C*, distal tarsi of first leg. All magnified.

abdomen are many more similar rows. The ventrum of abdomen is also provided with such rows, and the ventrum of the cephalothorax including coxæ is covered with these spines. Palpi large and longer than the body; thickly covered with long black spines; femur enlarging a little from base to apex; patella thick, subcylindrical, with a conical tubercle on ventral surface near distal end; tibia slightly petiolated, curved and attenuated distally, hollowed out on under side to receive tarsus; tarsus petiolated, swollen, a little more than half as long as tibia, rounded at end and having no claw; capable of being turned back upon the tibia like a thumb. Mandibles short, much shorter than body; first joint having a large, truncate, wart-like tubercle on dorsal surface near distal end; top of tubercle and dorsal surface of distal portion of the joint thickly furnished with stiff spinose hairs; second joint short and thick, provided dorsally with similar hairs; claws curved, unequal. Legs rather slender, with rows of spinose hairs on proximal joints. Shaft of genital organ long, flattened; toward tip enlarging into a spoon-shaped portion, from which there projects forward a long slender piece gradually coming to very acute point.

Described from one specimen taken at Hanover, New Hampshire.

CLARENCE M. WEED.

The Puparium of Jurinia.—In a paper recently sent to the AMERICAN NATURALIST, I described the puparium of *Blepharipeza*. The present paper describes the puparium of *Jurinia*, which genus, while it belongs to the same group as *Blepharipeza* (Hystriciinæ), shows considerable difference in the puparium. The description is drawn from a puparium of *Jurinia algens* Wd., from which issued a ♀ specimen of the fly, bred by Professor C. P. Gillette from *Hadena lignicolor*, in Colorado.

Puparium of *Jurinia algens* Wd.—Length, 12 mm.; greatest width (8th segment), 5½ mm. Color reddish brown, capital tubercles and anal stigmata blackish. Puparium consisting of 12 segments, including capital and anal plates, more or less cylindrical, bulging a little posteriorly, the anterior end being less in diameter than the posterior end, while the eighth segment is the widest portion. The rugose belts described in *Blepharipeza* are absent, the whole surface being more or less fluted, the flutings showing most plainly on the three anterior segments next the capital plate, becoming less distinct in the middle or giving way to an almost smooth surface, and reappearing in irregular flutings, or minute furrows and ridges, on the last three segments and

l plate. The larval mouth parts are represented on a portion of
capital plate forming part of the single anterior flap which is pres-
, by two small erect tubercles projecting straight out from the sur-
of the integument, situated at edge of capital plate, and on
osing sides. The remaining portion of the capital plate, which is
ent, the other flap being detached and missing, doubtless bears a
d similar erect tubercle, the three being so arranged that they
resent the corners of a nearly equilateral triangle. These tuber-
are erect, about as high as their basal diameter, ending in a blunt
laterally compressed apex, the apical diameter one way equalling
basal while the other way it is much less than the basal, the apical
face with about 4 faint transverse notches leaving 5 faint transverse
ges. The longitudinal axis of the compressed apex of each tubercle
t an angle of about 45 degrees with the margin of the capital plate.
surface of the capital plate is more or less irregularly transversely,
circularly, fluted. Anal stigmata situated in center of anal plate,
sisting of two erect raised organs, not as far apart as the diameter of
ier, each consisting of 3 ridge-like sections separated by deep
ches, the flap-like ridges of each stigma quite closely approximated
heir inner ends and widely divergent outwardly, the superior and
rior ones diverging at nearly a right angle. Each of these keel-
ridges bears a longitudinal median suture or fissure its whole
gth. These stigmatic organs, unlike those of *Blepharipeza* and
ny other tachinids, project straight out from the surface of the
gument, being about as high as their diameter. A little distance
trally (? dorsally) of the pair of anal stigmata, being situated on
erior border of 10th segment, is a small slit-like opening in the
gument resembling a spiracle, its longer diameter being longitudi-
to the puparium. The vent-like anal tubercle described in *Blepha-
eza* is not present.

Supplementary note to description of puparium of *Blepharipeza.*—
the description above referred to, of the puparium of *Blepharipeza
usta* Lw., I mentioned only one tubercle on the capital plate. This
s all that was present on the nearly detached anterior flap of the
parium, the correspondihg flap on the opposite side being missing.
hould have been mentioned that the absent portion of the capital
te doubtless bore two more tubercles similar to the one described,
ated near the edges of the plate as was also the latter, the three
ng arranged in a triangle, but not so far apart as in *Jurinia*, being
larger size.—C. H. TYLER TOWNSEND.

Notes.—In Bulletin No. 19 of the Iowa Experiment Station, Prof. Herbert Osborn reports further experiments in destroying leaf-hoppers; Mr. H. A. Gossard discusses the Clover-seed Caterpillar (*Grapholitha interstinctana*); and Mr. F. A. Sirrine treats of the Potato-stalk-weevil (*Trichobaris trinotata*). The latter species has been found breeding in "ground cherries" (*Physalis*).

Prof. S. W. Williston contributes to the third number of the Kansas University Quarterly the third part of his Diptera Brasiliana, and an illustrated paper on the Apioceridæ and their allies.

Mr. F. M. Webster publishes[3] extended accounts of the insects affecting the blackberry and raspberry, and the underground insect destroyers of wheat. The former article enumerates 88 species.

Mr. M. V. Slingerland[4] calls attention to the fact that the black peach aphis (*Aphis persicæ-niger*) is being introduced into New York through peach trees purchased in Delaware. The author describes the indications of the presence of the pest; its past history; its classification, appearance, and life history and remedial measures.

Professor J. B. Smith presents[5] an interesting illustrated discussion of the grasshoppers, locusts and crickets affecting cranberries. He shows that contrary to the usual belief it is the katydids and not the common grasshoppers that attack this fruit.

A catalogue of the South American species of Calyptrate Muscidæ by Prof. C. H. Tyler Townsend has lately appeared in the Annals of the New York Academy of Sciences. (Vol. VII, Dec., 1892).

---

[3] Ohio Agr. Expt. Station, Bulletins 45 and 46.

[4] Cornell Univers. Agr. Exp. Station, Bull. 49, p. 325.

[5] New Jersey Agr. Exp. Station, Bull. 98.

ARCHEOLOGY AND ETHNOLOGY.[1]

'he International Congress of Americanists.—(Continued
n page 305)—FIFTH CONGRESS AT COPENHAGEN, 1883.—The fol-
ers were read and addresses made:

bservations upon some of the skulls and human bones of the Min-
raes in Brazil, by M. Lutken; Note on the Quaternary Fossil
mals, Fauna of the Plateaux of the Andes; An Examination of
Discovery of the American Continent by Christopher Columbus,
the assistance given to him by Martin Alonzo Pinzon, by M. Her-
; Aboriginal American Literature, by Dr. Brinton; The Vineland
ursions of the Ancient Scandinavians, by M. Loffler; The Pre-
ombian Relations of the Gaels with Mexico, by M. Beauvois;
Scandinavian Ruins in the District of Julianehaab, South Green-
l, by M. K. Steenstrup, with two plates; Three Ancient Charts of
North, by Baron Nordenskiöld, explained by M. Christian Bahnson;
Lucien Adam, upon the theory announced by M. Hale, relative to
Origin of America; M. Bamps, On the Traditions Relative to the
ite Man and the Sign of the Cross in America, prior to the Dis-
ery; and a Criticism upon the Theory of Abbe Schmidt, which had
announced in the former Congress; The Lost History of America,
Mr. Steven Blackett; To what Point did the Ancient Scandinav-
Penetrate near the North Pole in their Expeditions over the
cial Sea? by M. Brynjulfson; The Voyages of the Brothers Zeni in
North, by M. J. Steenstrup; Nautical Remarks about the Zeni
ages, by M. Irminger; Cartography of the American Continent,
M. Anatole Bamps; The Voyages of the Danes in Greenland, by
Valdemar Schmidt; Peruvian Vases in the Archæologic Museum of
drid, by M. de la Rada; Polynesian Antiquities, a Link Between
Ancient Civilizations of Asia and America, by Mr. Francis A. Allen;
erican Pottery in Pate and Fabrication, by Anatole Bamps; On the
eolithic Implements of the Valley of the Delaware near Trenton, by
C. C. Abbott; Ancient Ornaments of Pottery, by E. Barber; Memoir
he Shell Mounds of the Chesapeake Bay and Potomac and Wyco-
Rivers, by Elmer T. Reynolds; Prehistoric Archæology, by
on Joseph de Baye; The Art of Ornamentation Among the Ameri-
People, by M. Stolpe; The Dialect of the Eskimo Language, with
noptical table of words arranged after the system of the Greenland

---

'his department is edited by Dr. Thomas Wilson, of the U. S. National Museum.

Dictionary by M. Rink. The author divides the Eskimos into six groups: the Greenlander, the Labradorian, the Eskimos of Makenzie, the Eskimos of the West, and the Aleutes—Wherein does the Eskimo Language Differ Grammatically from the other Languages of North America, by M. Lucien Adam; M. Leon de Rosny had made a Volume on the Deciphering of the Maya Inscriptions, the which M. Rada Translated and Presented to the Congress with an Analysis and Criticism; The Language Timucua, by M. Vinson; M. Vahl presented an ethnographic chart of North America for the Danish Missionary Society, which he explained; The Coloring Matter Employed by the American Indian, by M. Vera; The Variations in the Physical Geography of the American Continent, from the discovery to the present—M. Vera; and the Formation of the Words of the Maya Language, by the Count de Charencey.

The Fourth and Sixth Sessions were held respectively at Madrid, and Turin. I have no report of these Congresses.

The Seventh Session was held at Berlin from the 2d to the 5th of October, 1888. The papers read and addresses delivered were substantially as follows:

The Basques, Britons and Normans on the Coast of North America during the early part of the XVI Century, by M. Gaffarel, 9 pages; Publication of the Writings and Documents Relative to Christopher Columbus and his Time on the Occasion of the Celebration of the Fourth Centenary of the Discovery of America, by M. Cora; An Historical Essay on the Primitive Legislation of the Spanish State of America, by M. Fabie; On the Nahuatl Version of Sahagun's Historia de la Nueva Espana, by Dr. Brinton, with its discussion, 6 pages; On Certain Archæologic Objects of Mexico and South America, by M. Heger, 5 pages; The Stone Colliers of Porto Rico, by Jimenez de la Espada; Antiquities of Vera Cruz; Archæologic Results of the Later Voyages in Mexico, by M. Seler; An Ancient Mexican Mosaic, by M. Andree; Notes on the Origin, Working Hypothesis and Primary Researches of the Hemenway Southwestern Archælogical Exposition, by Mr. F. H. Cushing; The Antiquities of Nicaragua, by M. Bovallius; The Ceramic Antiquities of the Isle of Marajo, and also on Nephrite and Jadeite, by M. Netto; Place of Origin of Nephrite and Jadeite, by M. Virchow; The Aztecs and their Probable Relation to the Pueblo Indians of New Mexico, by Mr. S. B. Evans; The Employ of Cocoa in the Northern Part of South America; American Craniology, by Virchow; An Anatomical Characteristic of the Hyoid Bone of Pre-Columbian Pueblo Indians of Arizona, by Drs. Wortmann and Ten

Kate; The Chronology of Dilluvial Man in North America, Emile Schmidt; Indication of the Vestiges of the Pre-Columbian Population of Nicaragua, M. Desiré Pector; Human Sacrifice in America During Pre-Columbian Times, by M. Grossi; Cremation in America Before and After Christopher Columbus, by M. Grossi; Anthropology of the People d'Anahuac in the Times of Cortez, by M. Hartmann; Was America Peopled from Polynesia? by Horatio Hale; Study of the Mam Language, by the Comte de Charency; Vocabulary of the Language Timucua, by M. Raoule de la Grasserie; The Linguistic Family of Pano, by the same; The Historic Archives of the Hemenway Southwestern Archæological Expedition, by M. Bandelier; On the Sambaquis of Brazil, by M. H. Muller; Ancient Map of America, by Gaffarel; Three Linguistic Families in the Amazon and Orinoco Rivers, by M. Adam; Bibliography of Recent Linguistic Investigations in South America, by the same; Maya Handwriting by M. Förstemann; A Chronologic Classification of the Architectural Monuments of Ancient Peru, by M. Borsari; Contribution to Americanism of Cauca (United States of Columbia) by M. Douay; The Language of the People of the Center of South America by M. Von Den Steinen; Peruvian Figures in Silver, by M. Luders.

Language vs. Anatomy in Determining Human Races.—"Anthropologie," replying to criticisms of Dr. Sergi's work, thus states the position of French Anthropologists on this controverted subject:

The Anthropologists of France are unanimous that some or a few (anatomic) characters are not sufficient to determine a type of race; but there should be an investigation of all or as many as possible, and Anthropology does not interfere with Ethnography. They are occupied with different things. Anthropology does not say that physical characters are superior or inferior to linguistic characters; it says the two sciences are of a different order and for a different purpose. The first relates to the physical element constituting peoples; the second to the classification of these peoples. Language grows, loses, borrows, changes, transforms, and all this independent of the Anthropological characters, such as beliefs, customs, industries. Physical characters are hereditary and inherent in the blood, while linguistic characters are not. A red Indian, born among strangers and without the society of his parents or race, will speak, not his own language, but the language of those who rear him, and, nevertheless, retain all the physical characters of his race. Different and opposing races may speak the same language, and per contra, the same race may speak different languages.

Much of the contest which has developed in the United States as to the relative value of language arises from the confusion of the terms Anthropology, Ethnology, Ethnography. The French writer makes a distinction easily understood and maintained, and quite harmonious with the "Nomenclature of Anthropology" as presented by Dr. Brinton and commented on by Major Powell before the Anthropological Society of Washington (Amer. Anthrop., July, 1892, Vol. V, No. 3, p. 265, et seq).

Language may be of great value, and should never be neglected in determining living or historic races. In determining prehistoric races, it cannot be studied because in most cases it is unknown, and so we are driven to consider the physical characters. Because language assists in determining historic races, it does not follow that in the prehistoric races no other means can be used.

The true rule seems to require the employment of all possible means, and even then the decision may not be either harmonious or correct.

The Nephrite of New Zealand.—MM. Duparc and Morazec have published in the Archives of Natural and Physical Science, Geneva, a paper on Nephrite of New Zealand. Speaking of the number of hatchets and other objects from the Swiss Lakes in the museums which have passed as Nephrite, they express doubt and counsel circumspection. They do right and are to be approved. But when they say that they have found but one piece which from its appearance could be identified as nephrite, their proposition is doubtful. There are many polished specimens of the hard, greenish stone in the Swiss Museums, which stand tests of hardness and density required for Nephrite, and which have been called so. If not Nephrite, they are still some varieties of Jade. One or more of their components may be soda or aluminum instead of lime or magnesia ; and they may be Jadeite, fibrolite, saussaurite or another variety of Jade.

While many of these polished objects can be determined with reasonable certainty on inspection and from appearance, yet there are many which possibly cannot be. That is to say, they correspond in appearance, and they stand the tests of hardness and density, and may be either the one or the other, depending upon their chemical combination, and this similarity may be so great that it is doubtful if, in disputed cases, anyone can determine without analysis or microscopic examination of thin sections. If MM. Dupare and Morazec examined the doubtful or contested specimens of the Swiss Museums in this way, their determination would be accepted, but if from mere external appearance, the subject is still open. Their conclusions may be quite correct, but examination from external appearance does not prove it. One great trouble arising in the discussion of this subject is that the destruction of the object consequent upon analysis and thin section prevents a satisfactory and competent determination.

MICROSCOPY.[1]

A Method for Injecting the Blood-Vessels in Birds.— I presume all who give a laboratory course in Comparative Anatomy have, in common with myself, experienced difficulty in injecting the arterial and venous systems of birds. The usual directions are to inject the arterial system through the pectoral artery, and the venous system either through the pectoral vein or through the coccygeo-mesenteric vein. The blood of birds coagulates very rapidly, and even when the procedure is carried out as expeditiously as possible, failure frequently occurs from the inability of the operator to remove the greater part of the blood from the animal, or from vexatious delays in tying a canula in the divided vessel. For some time I have been using the following method, and have not failed in securing the most satisfactory results. It possesses the additional advantage of being quickly performed.

The bird, a pigeon for example, is placed under a bell-jar and chloroformed in the usual way. While the bird is getting under the influence of the anesthetic, the operator should see that there is, within convenient reach, a scalpel, a pair of stout scissors with both points rounded off, two canulae and the necessary ligatures for tying them in place.

As soon as the pigeon is thoroughly under the anesthetic, the bell-jar is removed, a towel is wrapped about the head and a few drops of chloroform poured over it; the feathers are rapidly plucked from the breast and abdomen to a point just anterior to the cloaca; the skin is divided the entire distance over the keel, and the pectoral muscles dissected off from their attachment to the keel and body of the sternum for a distance of half an inch on either side of the keel.

The muscles attached to the posterior margin of the sternum are next divided close to the sternum for the distance of half an inch on either side of the median line; now raise the sternum carefully and divide the attachment of the heart. Beginning at the outer angle of the divided abdominal muscles, the body of the sternum is cut through with the stout, blunt-pointed scissors, in a direction forward and inward, until a point is reached directly over the origin of the vascular trunks; repeat on the opposite side. Now grasping the keel firmly with the left hand, make traction directly upward, at the same time steadying the bird with the right hand; by this procedure the sternum is broken equally across, and the heart exposed without causing any damage to it or to the vascular trunks. Next, tear the pericardium open as quickly as possible, seize the heart, still strongly beating, between the thumb and index finger of the left hand, invert the bird over a sink and cut off with the blunt-pointed scissors the apex of the heart. In this way the blood-vessels are thoroughly emptied and the bird killed without any unnecessary suffering.

---

[1] This department is edited by C. O. Whitman, University of Chicago.

Although the description of the procedure may make it seem long, I have repeatedly done it in less than three minutes.

A canula is now inserted through the left ventricle into the aorta, and a ligature placed around it close to the point where the aorta leaves the heart. In passing the ligature around the canula, care should be exercised not to injure the vena cava or the right auricle. A second canula is passed through the right ventricle into the right auricle and secured by tying a stout ligature about the whole heart.

I have found that the best injecting mass is Gage's modification of Pausch's, colored with vermilion or ultramarine blue; this does not pass through the capillaries, sets quickly, leaving the vessels well-distended with a firm mass.

I employ a constant pressure apparatus in injecting, using a pressure of 100 mm. for the artery, but only 60 mm. for the vein; more than this will usually cause a rupture.

W. S. Miller.

Univ. of Wisconsin.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—The following papers were read at the meeting commencing April 18, 1893: On the Systematic Relations of the Ophidia, E. D. Cope; Biographical Memoir of General Montgomery C. Meigs, H. L. Abbott; On the Nature of Certain Solutions, and on a New Means of Investigating Them, M. C. Lea; The Relations of Allied Branches of Biological Research to the Study of the Development of the Individual, and the Evolution of Groups, A. Hyatt; The Endosiphonoidea (Endoceras, etc.), considered as a New Order of Cephalopods, A. Hyatt; A New Type of Fossil Cephalopods, A. Hyatt; Results of Recent Researches upon Fossil Cephalopods of the Carboniferous, A. Hyatt; Biographical Memoir of Julius Erasmus Hilgard, E. W. Hilgard; Monograph of the Bombycine Moths of America, North of Mexico: Part I.—Notodontidæ, A. S. Packard; Intermediary Orbits, G. W. Hill; The Relations Between the Statistics of Immigration and the Census Returns of the Foreign-born Population of the United States, Richmond Mayo-Smith; Statistical Data for the Study of the Assimilation of Races and Nationalities of the United States, Richmond Mayo-Smith; Telegraphic Gravity Determinations, T. C. Mendenhall; Comparison of Latitude Determinations at Waikiki, T. C. Mendenhall; A One-volt Standard Cell; H. S. Carhart (introduced by T. C. Mendenhall); Fundamental Standards of Length and Mass, T. C. Mendenhall; Peptonization in Gastric Digestion, R. H. Chittenden; Helen Kellar, Alexander Graham Bell; On a Potentiality of Internal Work in the Wind, S. P. Langley; On a Bolograph of the Infra-red Solar Spectrum, S. P. Langley.

No election of members took place. The following were elected foreign correspondents: Tissandier, astronomer, Paris; Rammelsberg, chemist, Berlin; Ludwig, physiologist, Leipzig.

Boston Society of Natural History.—April 19.—The following papers were read: Mr. J. B. Woodworth: Traces of a Fauna in the Cambridge Slates; Mr. Charles P. Bowditch: Ruins of Central America. The annual meeting was held May 3d. The following paper was read: Dr. R. T. Jackson—Notes on the Development of Palms. SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences.—April 10, 1893.—*Biological Section.*—H. F. Osborn, on "The Evolution of Teeth in Mammalia in its Bearing Upon the Problem of Phylogeny," reviewed the recent researches and theories of Kükenthal, Röse and Taeker upon the formation and succession of the dental series in mammalia, and pointed out that, especially in marsupials, cetaceans and edentates (with other placentalia) the existence of two series of teeth was now abundantly proven, as well as the fact that *Homodynamous* forms were derived from early *Heterodont.* He then showed that recent discoveries demonstrated that in marsupials, teeth of the second series might be interposed in the first series—to explain the typical dentition of such forms as Didelphys. This transposition enables a comparison of dentition of marsupials with that of Jurassic mammalia (= i, $\frac{4}{4}$, c, $\frac{1}{1}$, p, $\frac{4}{4}$, m, $\frac{8}{8}$). It was further noted that the triconodont type (as Amphilestes) was probably the hypothetical point of divergence of placental mammalia. As to the form of crowns, the theory (Kükenthal-Röse) that complex mammalian types were made by concrescence of simple reptilian cusps was upon the evidence of the Jurassic mammalia shown untenable, as well as the converse theory that cetaceans have derived their homodynamous form by the splitting of the cusps of triconodont.

Bashford Dean, in "Contributions to the Anatomy of Diniththys," correlated the parts of this Devon-Lower Carboniferous Arthrodiran to those of Coccosteus. Notes were made upon the (1) disposition and character of the lateral line organs, (2) pineal foramen, (3) nasal capsules, (4) dentary plates (homologies), (5) ginglymoid articulation of lateral shoulder plates, (6) character of shagreen, (7) probable disposition of paired and unpaired fins.

N. L. Britton presented a "Note on the Genus *Lechea.*" This genus of *Cistineæ* is entirely American, and from the investigations of Mr. Wm. H. Leggett and Dr. Britton appears to consist of about fourteen species.

Natural Science Association of Staten Island.—March 18.—Mr. Wm. T. Davis exhibited specimens of the Leopard Moth and read the following communication:

On the 23d of June, 1888, I found on the sidewalk, under a partly decayed white maple on Fort Hill, a large white and black moth that was rendered helpless by having one of its fore wings broken in two. It was not until last year, when Col. Nicholas Pike's article and accompanying figures on the ravages of the Leopard Moth—*Zeuzera æsculi* (Linn.)—in Brooklyn, appeared in "Insect Life," that the moth found by me was proved to be the same species from Staten Island. Col. Pike found in 1889 that it had bored nearly all of the trees, mostly maples, from Carlton Avenue to the entrance of the park, and that in 1891 it had extended its ravages throughout the city. He also mentioned it as having appeared in Astoria, New Rochelle, Jamaica, New Lots and Flatbush.

In August, 1887, Mr. J. B. Engelman took three specimens of the Leopard Moth in Newark, N. J., and in 1888 many more were found. Previous to this the very rare occurrence of the moths in this country had been credited to the importation of wood containing the larvæ. In 1889, Mr. Beutenmuller mentions it as having been found not uncommonly in Central Park. From these facts it will be seen that this destructive insect from the Old World has become quite generally distributed in this vicinity.

Mr. Davis also read the following note:

With Messrs Kerr and Leng, on the 26th of last February, I observed about twenty-five Snow Buntings—*Plectrophenax nivalis* (Linn.)—in a field on Todt Hill, near the highest point of the island. They were feeding in the few places where there was no snow, and flew occasionally in a remarkably compact flock, from one to another of these isolated spots. This bird has not been reported on the island for a number of years, and its present occurrence is undoubtedly due to the severity of the winter.

Mr. J. H. Bowles, in "Science," for January 13th, 1893, comments upon the abundance of the Pine Grosbeak—*Pinicola enucleator* (Linn.) —and the scarcity of the Snow Bunting about Ponkapoag, in eastern Massachusetts, and gives as a cause the unusually cold weather. The Grosbeaks and the Buntings have each ranged further south than for several years past. Though the weather has been severe, robins have been seen sparingly on the island during every month of the winter.

Mr. Arthur Hollick remarked that the last time he remembered seeing the Snow Buntings in abundance in this vicinity was during the winter of 1872–73, when they appeared in great flocks, accompanied by the Horned Lark—*Otocoris alpestris* (Linn.). That winter they were particularly numerous on Fort Hill, New Brighton, during many days in December and January, and large numbers were killed by gunners.

Mr. Walter C. Kerr exhibited, under the microscope, leaves of *Quercus nigra* L., *Q. ilicifolia* Wang., and *Q. brittonii* Davis, and read the following paper in connection with them:

In describing the new hybrid, *Quercus brittonii*, in our Proceedings for September 10th, 1892, Mr. Davis refers to the pubescence of the under surface of its leaves being intermediate between that of *Q. ilicifolia* and *Q. nigra*. This observation was made from casual inspection, without reference to the exact nature of the pubescence. Under the microscope it will be seen, as in specimens submitted, that the *Q. ilicifolia* has so dense a pubescence that the epidermis is completely hidden, while in *Q. nigra* the tufts are quite separated, even isolated. In *Q. brittoni*, the hybrid between these species, the intermediate character of the pubescence is most striking, the under surface of the leaves being starred at regular intervals by the tufts, which are usually sufficiently close to allow their spreading hairs to touch one another. These tufts seem to be composed of six to twelve hairs spreading from a common base and occupying a space about .15 to .2 mm. in diameter.

An average specimen contains about sixteen tufts per square mm., while in any other, representing the strongest pubescence which the hybrid seems to attain, about twice this number were present and somewhat smaller in size, indicating considerable variation in these appendages.

The wide difference in pubescence of *ilicifolia* and *nigra*, however, is such that a variation of even one hundred per cent. between different specimens of *Q. britonii* is not sufficient to materially affect the distinctiveness of this characteristic.

Mr. Arthur Hollick called attention to the fact that an earthquake shock had been experienced on the island shortly after midnight on March 8th, which had been sufficiently severe to awaken many people, especially those who resided on the hills in New Brighton, but that it did not seem to have been felt generally throughout the rest of the island.

Mr. Jos. G. Thompson stated than he found, on South Beach, a dead specimen of the Tom-Cod (*Gadus tomcodus*), about eight inches long, which had made a meal of eight mud-killies (*Umbri limi*). Those that were in the foremost part of the stomach were quite perfect, while the others that were further down had begun to be dissolved by the digestive fluids.

April 8.—Mr. Arthur Hollick exhibited specimens of Indian rubbing stones and read the following paper concerning them:

Since our last meeting, while on a tramp across the island from Pleasant Plains to Rossville, I was struck by the fact that the shell heaps, which have been noticed in that region at different times, form practically a continuous chain or trail from shore to shore. They follow ıe course of Sandy Brook up to Woodrow road, and from thence may e found in nearly every field or piece of cleared ground until we reach ıe village of Rossville. Indian implements of various kinds, with agments of pottery have been picked up at many points and are kely to be met with in any part of the region. The distance of some f these accumulations from the shore, their elevation above the water, ıd the fact that in many places they are spread thinly and evenly on ıe surface has led me to think that the more distant ones from the ılt water may have been carried there in recent times by the farmers r purposes of fertilization, as is frequently done. Whether this be or not, implements may be found wherever the shells occur, prov- g their origin indisputably.

Amongst a number of relics found at the time mentioned was an nusually fine specimen of a rubbing or polishing stone—an imple- ent of which few have turned up on Staten Island, and in regard to hich I believe, the attention of the Association has never been called. mongst the hundreds of implements which our members have col- cted during the past ten or twelve years from all parts of the island, find but seven which can be classed in this category—all, with the xception of this one, from Tottenville.

Mr. William T. Davis presented nine plants, new or rare to the flora f the Island, with the following memoranda:

Rubus odoratus L. Side of Todt Hill road near the highest point. preading from introduced plants. *Aethusa cynapium* L. Abundant a field corner Crescent and Jersey streets, New Brighton. Pre- iously reported only from Clove Lake swamp. *Oxycoccus macrocarpus* ers. Near Sprague avenue, Tottenville, and accompanied by the Cotton grass" (*Eriophorum*) as in the swamp near Richmond village. *accinium pennsylvanicum* Lam. Watchogue and Arlington. *Stachys ılustris* L. var. *cordata*. Abundant in field near Eltingville station. *inus mitis* Michx. Abundant at Linoleumville. *Habenaria bleph- riglottis* Hook. Sparingly at Watchogue along Merrill's road. *Calo- ogon pulchellus* R. Br. Merrill's road near trap ridge. Collected by . W. Leng. *Smilacina stellata* Desf. Borders of salt meadow at reat Kills.

Mr. Walter C. Kerr exhibited a large fragment from the broken unk of a horse chestnut tree, showing profuse budding, and read the llowing paper:

Some features surrounding the adventitious budding of a horse chest- ıt, *Æsculus hippocastanum* L., on Tompkinsville Hill may be worthy f passing notice. On the bleak eastern brow of the hill there stands, among the few scattered trees remaining, a horse chestnut about 18 inches in diameter, branching about three feet from the ground into two trunks, each about ten inches in diameter. The trunk leaning to the eastward is thriving and about the normal height for its diameter. The one leading to the westward has broken off, with an irregular splintery fracture, about five feet from the ground, perhaps on account of its lesser resistance to our easterly gales, and the stump has rotted badly. The bark, however, retains its vigor, and from the cambium layer, where exposed along the irregular edges of the ruptured section, adventitious buds have sprouted profusely. They are also found where the bark has split, and in the crotch where the tree has forked, where the bark of the two trunks unite. Some of the thickest colonies of buds were at the apex of the splintered stump, and I therefore sawed off about fifteen inches with its buds and three young shoots which have seemed fortunate enough to grow to the length of some eight inches. It will be noted that the bark is in a good state of preservation, the inner layers alive, while the wood is not only dead, but far gone in decay. The thickest cluster of buds is 8 inches long by 1½ inches wide, and within this space I have counted 200, about 30 of which are alive, the others being mostly the remains of a previous crop. There is no evidence of accidental destruction of the buds, though a few small shoots may have been cut off. Cows would scarcely browse on them, and one cluster occupied an inaccessible position in the fork.

One is not surprised at the dense growth of shoots which rise from adventitious buds on a decapitated willow or the spraying branches of elm which are of similar origin, but I have never before noticed so profuse a crop of buds whose mission seems to be entirely futile. They seem to represent an especially vigorous effort of the broken organism to survive, and under the circumstances this effort might be very persistent because of the opportunity afforded the unfortunate trunk, deprived of means of assimilation, to draw on the sister trunk, fully developed, for the requisite nourishment. It therefore might seem to have more opportunity to thus maintain its life than had it been a single trunk snapped off and dependent only on the residual nourishment within its roots. This supposition is, in some degree, supported by the fact that this particular tree stands on a hill some 300 feet high, rooted in the thin, dry soil covering a barren serpentine ledge, and hence would scarcely be expected to show a vigor which compares favorably with the sprouting of the adventitious shoots of the brookside willow. The specimen from the stump shows only three small surviving shoots, and may it not be fairly surmised that if the budding effort

the cambium layer of this old stump could have been concentrated
o a few buds and their resultant shoots, the struggle for existence
uld have been more successful. It would seem, even in the absence
positive evidence, as though the prolificness with which the buds
re formed seriously retarded the survival of any, and thus the abil-
of the cambium layer of this stump to restore the interrupted
owth was handicapped by the opportunity afforded for abnormal
dding effort through the supply of nourishment obtainable from the
injured half.

Mr. George Dupuy exhibited a series of about 400 drawings repre-
nting Staten Island pond life—diatoms, desmids, algae and infusoria
all drawn to scale on cards, handsomely colored and arranged.

The Biological Society of Washington.—April 8.—The fol-
wing communications were made: Professor J. W. Chickering—The
otanical Landscape; Frederick V. Coville—Characteristics and
daptations of a Desert Flora; Dr. C. W. Stiles—Notes on Parasites;
e Cause of "Measly Duck," with microscopic demonstration; Dr.
R. Gurley—Natural Selection as Exemplified by the Cackling of
ens.

April 22.—The following communications were made: Mr. O. F.
ook—Notes on the Natural History of Liberia; Dr. J. N. Rose—
wo New Trees of Economic Importance from Mexico; Dr. V. A.
oore—Observations on the Distribution and Specific Characters of
e Streptococci Group of Bacteria; Dr. Erwin F. Smith—Peach Yel-
ws and Plant Nutrition. FREDERICK V. COVILLE, *Secretary.*

Geological Society of Washington.—A Geological Society has
cently been organized in Washington, D. C., for the presentation and
iscussion of topics of interest to geologists. The constitution and
anding rules were subscribed to by 109 founders at the first public
eeting, March 8th, 1893. Its members are of two classes, active and
rresponding. The annual dues of the first are $2, and of the second,
1. Meetings will be held on the second and generally also on the
urth Wednesday of each month from October to May, inclusive.

The journals and bulletins of the various societies appear to furnish
fficient opportunity for the publication of papers read before the
ociety, so that for the present the Society will not undertake to pub-
sh the papers presented. It will probably issue one bulletin each
ear containing the address of the retiring President, and such other
atter as the Council directs. J. S. DILLER, *Secretary.*

SCIENTIFIC NEWS.

Correction.—Dr. D. S. Jordan informs me that the name *albeolus* is not available for a new species of *Notropis* since it has been used in that connection. The species called *Notropis albeolus* in the AMERICAN NATURALIST, January, 1893, p. 152, may stand as *Notropis jordanii.* C. H. & R. S. EIGENMANN.

Alphonse Louis Pierre Pyramus DeCandolle, born in Paris, October 27, 1806, died in Geneva, April 4, 1893. The son of an eminent botanist (Augustin Pyramus DeCandolle, 1778–1841), with whom he labored many years, and himself the father of one who ranks high among living botanists (Casimir Pyramus DeCandolle, 1836——), the subject of this sketch lived all his days a botanist. His first paper, *Monographie des Campanulées,* appeared in 1830, and from that date until within a short time, his brain and pen have been busy. In 1839 he began his contributions to the "Prodromus" which his father had inaugurated fifteen years earlier, continuing until the final abandonment of the work in 1873. A few years later (1878) he and his son Casimir brought out the first volume of *Monographiae Phanerogamarum,* which was intended as in part, a continuation and revision of the *Prodromus.* Of this great work, seven stately volumes have appeared.

Aside from this systematic and descriptive work, DeCandolle will be remembered for his treatise on geographical botany, *Geographie Botanique Raisonnée* (2 vols., 1855), and his well known *Lois de la Nomenclature Botanique* (1867), of which an English translation appeared the year following. The latter, in these days of discussion, is not likely to be forgotten or overlooked. *La Phytographie,* which appeared from his pen in 1880, is not as well known as its merits deserve. The much more popular *Origin du Plants Cultivés* (1885), of which an English translation appeared in the International Scientific Series is one of the most widely read of botanical works.

Lectures at the Paris Museum.—The following course of lectures will be given at the Museum of Natural History during 1893:

April 25, Preliminary Lesson, M. Milne-Edwards; April 27, Anthropology, M. Hamy; April 29, Ethnography, M. Verneau; May 2, Mammalia, M. Oustalet; May 4, Birds, M. Oustalet; May 6, Reptiles and Fishes, M. Vaillant; May 9, Molluscs, M. Perrier; May 13, Worms and Zoophytes, M. Bernard; May 16, Insects and Crustaceans, M. Ch. Brongniart; May 18, Comparative Anatomy, M. Pouchet; May 20, Botany (Phanerogams), M. E. Bureau; May 23, Botany (Wood, Cryptogams), M. Van Tieghem; May 25, Living Plants, M. Cornu; May 27, Paleontology, M. Albert Gaudry; May 30, Geology, M. Stanislas Meunier; June 1, Meteorology, M. Daniel Berthelot; June 3, Mineralogy, M. Lacroix; June 6, Hygiene for Travelers, M. Gréhaut. (Revue Scientifique, April, 1893.)

The Nottingham Meeting of the British Association for the Advancement of Science will be held under the presidency of Professor Burdon-Sanderson, the well-known physiologist. The presidents of the Natural History Sections are to be: Geology, J. J. H. Teall; Biology the Rev. Canon Tristram; Geography, Mr. Henry Seebohm; Anthropology, Dr. Robert Monro.

Dr. Dall has done a good work in ascertaining the dates of the late Timothy A. Conrad's books upon the Tertiary fossils of the United States. The quarrel which was their cause or their effect has fortunately passed into ancient history, and these unfortunate volumes show the ground of its permanent settlement.

The cousins Sarasin, so well known for their expedition to Ceylon to study the development of the Cæcilians, are about to start for a several years' stay in the Celebes.

The Rev. H. N. Hutchinson, 30 Vincent Square, Westminster, London, S. W., England, has, for sale, plaster casts of a model of the horned saurian Agathaumas, 12 inches long, for ten shillings.

Professor Karl August Lossen, Chief Geologist of the Prussian Survey and Professor of Geology in the University of Berlin, died February 24, 1893. Most of his geological work was done in the Hartz Mountains. He was born January 5, 1841.

Professor Karl Prantl, of the University of Breslau, died February 24, 1893, in his forty-fourth year. He is best known for his text-book translated by Professor Vines, and for his share in the "Pflanzenfamilien" of which he and Professor Engler of Berlin were joint editors. This work is, however, so near completion that it will probably be but slightly delayed. He also edited the Moss magazine, "Hedwigia."

Edward Parfitt, a student of the Geology of Devonshire, England, died June 15, 1893, in his 73d year.

The Marine Biological Laboratory at Woods Hall, Mass.

INCORPORATED IN 1888. SIXTH SEASON, 1893.

OFFICERS OF INSTRUCTION.

C. O. Whitman, Director, Head Professor of Zoology the University of Chicago; Editor of the Journal of Morphology.

ZOOLOGY.

A. *Investigation.*

Howard Ayers, Director of the Allis Lake Laboratory, Milwaukee; J. Playfair McMurrich, Professor of Biology, University of Cincinnati; E. G. Conklin, Professor of Biology, Ohio Wesleyan University; F. R. Lillie, Fellow in Zoology, Chicago University.

B. *Instruction.*

H. C. Bumpus, Professor of Comparative Anatomy, Brown University; W. M. Rankin, Instructor in Zoology, Princeton College; Pierre A. Fish, Instructor in Physiology and Anatomy, Cornell University; A. D. Mead, Fellow in Zoology, University of Chicago.

BOTANY.

W. A. Setchell, Instructor in Botany, Yale University; W. J. V. Osterhout, Brown University.

PHYSIOLOGY.

Jacques Loeb, Assistant Professor of Physiology, University of Chicago.

Ryoiche Takano, Artist; F. W. Walmsley, Collector; G. M. Gray, Laboratory Assistant.

In addition to the regular courses of instruction in Zoology, Botany, Embryology and Microscopical Technique, consisting of lectures and laboratory work under the constant supervision of the instructors, there will be a number of lectures on special subjects by members of the staff. A course of lectures in Embryology will be given by Professor Whitman; on the Morphology of Vertebrate Head, by Dr. Ayers, and two or more courses in Invertebrate Zoology, by Drs. Bumpus, McMurrich, Rankin and Morgan.

There will also be ten or more evening lectures on biological subjects of general interest. Among those who may contribute these lectures may be mentioned, in addition to the instructors above-named, the following:

Drs. E. A. Andrews, Johns Hopkins University; Howard Ayers, of the Allis Lake Laboratory; Professors W. G. Farlow, Harvard University; William Libbey, Jr., Princeton College; J. M. Macfarlane, University of Pennsylvania; C. S. Minot, Harvard Medical School; E. S. Morse, Salem; H. F. Osborn, Columbia College; John A. Ryder, University of Pennsylvania; W. T. Sedgwick, Mass. Institute of Technology; E. B. Wilson, Columbia College.

The Laboratory is located on the coast at Woods Holl, Massachusetts, near the Laboratories of the United States Fish Commission. The building consists of two stories, and has 33 private laboratories for investigators and 5 general laboratories—two for beginners in investigation in Zoology, one for teachers and students receiving instruction in Zoology, one for Botany, and one for Physiology. The Laboratory has aquaria supplied with running sea water, boats, a steam launch, collecting apparatus and dredges; it is also supplied with reagents, glassware and a limited number of microtomes and microscopes. *No alcohol can be supplied beyond what is required for work in the laboratory.*

By the munificence of friends, the library will be provided not only with the ordinary text-books and works of reference, but also with the more important journals of zoology and botany, some of them in complete series.

THE LABORATORIES FOR INVESTIGATORS

will be open from June 1 to August 30. They will be equipped with aquaria, glassware, reagents, etc., *but microscopes will not be provided.* In this department there are 33 private laboratories for the exclusive use of investigators.

Those who are prepared to begin original work under the guidance of instructors, will occupy tables in the general Laboratories for Investigators, paying for the privilege a fee of fifty dollars. The number of such tables is limited to 20.

An Elementary Course in vertebrate embryology will be introduced this season, designed to meet the needs of those who have completed the general courses in the Students' Laboratory. The study will be confined mainly to the fish egg, as the best type for elucidating vertebrate development. Each member of the class will be supplied with material, and be expected to work out each step in the development from the moment of fecundation. The aim will be not only to master the details of development, but also to acquire a thorough knowledge of the methods of work. Methods of preparing surface views, imbedding in paraffin and celloidin, various methods of staining and mounting, drawing, reconstructing, modeling, etc. The course will thus combine just what is needed as a preparation for investigation.

This course will open Wednesday, July 5, and continue six weeks, and it will be conducted by Mr. Lillie and Professor Whitman. The fee for this course will be fifty dollars, and the class be limited to ten.

Applicants should state what they have done in preparation for such a course, and whether they can bring a complete outfit, viz.: a compound microscope, a dissecting microscope (the Paul Mayer pattern made by Zeiss is the best), camera-lucida, microtome, etc. In case these instruments are furnished by the Laboratory, an additional fee of ten dollars will be charged therefor. No application for less than the whole course will be granted.

THE ZOOLOGICAL LABORATORY FOR TEACHERS AND STUDENTS

will be opened on Wednesday July 5, for regular courses of six weeks in Zoology and Microscopical Technique. The number admitted to this department will be limited to fifty, and preference will be given to teachers and others already qualified. By permission of the Director and by the payment of additional fees, students may begin their individual work as early as June 15, but the regular instruction will not begin before July 5.

Though more advanced students who may wish to limit their work to special groups will have an opportunity to do so, the regular course in Zoology, in charge of Professor Bumpus, will embrace a study of the more typical marine forms and elementary methods of Microscopical Technique. The Laboratory work, outlined below, will be accompanied by lectures.

July 5–8, Study of the Lobster (general anatomy, methods of injecting, preparation of histological material); July 10–15, Coelenterates (*Campanularia, Tubularia, Metridium, Mnemeopsis*); July 17–22, Vermes (*Nereis, Balanoglossus* and *Phascolosoma, Polyzoa, Bdelloura*); July 24–29, Echinoderms (*Asterias, Arbacia, Echinarachinus, Thyone*); Molluscs (*Venus, Sycotypus, Loligo*); July 31–Aug. 5, Crustaceans (*Branchipus, Pandarus, Lepas, Idotea, Talorchestia, Cancer, Limulus*); August 7–15, Vertebrates (*Amphioxus, Raja*, Teleost).

The tuition fee is thirty-five dollars, payable in advance. Applicants should state whether they can supply themselves with simple and compound microscopes, or whether they wish to hire. Microscope slides, dissecting and drawing instruments, bottles, and other supplies, to be finally taken away, are on sale at the Laboratory. Further information in regard to this department may be had by addressing Professor Hermon C. Bumpus, Woods Holl, Mass., to whom applications for admission should also be made.

THE BOTANICAL LABORATORY FOR TEACHERS AND STUDENTS will be opened on Wednesday, July 5. The laboratory work in Botany will be restricted to the study of the structures and development of types of the various orders of the Cryptogamous Plants. Especial attention will be given to the study of the various species of Marine Algæ which occur so abundantly in the waters about Woods Holl, and students desiring to give their entire attention to these plants will be encouraged to do so. The Fungi and Higher Cryptogams will receive less attention than the Algae, and will be studied in fewer types. Lectures will accompany the laboratory work. The course may be outlined somewhat as follows:

First week, *Cyanophyceæ*—Lyngbya, Calothrix, Rivularia, Stigonema, Tolypothrix, Anabæna. Second week, *Chlorophyceæ*—Spirogyra, Ulva, Enteromorpha, Chætomorpha, Bryopsis, Vaucheria, Œdogonium; *Phaeophyceae*, Ectocarpus, Mesogloia, Leathesia, Laminaria, Fucus, Sargassum. Third week, *Rhodophyceæ*—Batrachospermum, Nemalion, Callithamnion, Chondriopsis, Rhabdonia. Fourth week, *Phycomycetes*—Mucor, Sporodinia, Peronospora, Cystopus, Achlya; *Uredinei*, Æcidium, Uredo, Puccinia, Uromyces. Fifth week, *Basidiomycetes*—Agaricus, Lycoperdon; *Ascomycetes*—Microsphæra, Sordaria, Peziza, Physcia. Sixth week, *Muscineæ*—Riccia, Madotheca, Marchantia, Mnium, Tetraphis, Hypnum; *Filicineæ*—Dicksonia, Adiantum, Equisetum, Lycopodium, Marsilia, Selaginella.

The tuition for students in the regular course of laboratory work and lectures is thirty-five dollars, payable in advance; for students engaged in investigation the tuition is fifty dollars.

Students are expected to supply their own instruments, or to pay an extra fee for those borrowed from the Laboratory. Applications should be addressed to William A. Setchell, 2 Hillhouse Ave., New Haven, Conn.

The Physiological Laboratory will be open from June 1 to September, for investigators.

Rooms accommodating two persons may be obtained near the Laboratory, at prices varying from $2.00 to $4.00 a week, and board from from $4.50 to $6.00. By special arrangement, board will be supplied to members at The Homestead at $5.00 a week.

A DEPARTMENT OF LABORATORY SUPPLY

has been established in order to facilitate the work of teachers and others at a distance, who desire to obtain materials for study or for class instruction. Certain sponges, hydroids, starfishes, sea-urchins, marine worms, crustaceans, molluscs, and vertebrates are generally kept in stock, though larger orders should be filled some time before the material is needed. Circulars giving information, prices, etc., may be obtained by addressing the Collector, Mr. F. W. Walmsley, Woods Holl, Mass.

AUG 2 1893

THE
AMERICAN NATURALIST

VOL. XXVII. July, 1893.

SOME CORRELATIONS OF ONTOGENY AND PHYLOGENY IN THE BRACHIOPODA.

BY C. E. BEECHER.

The parallelism between the ontogeny and phylogeny in the Brachiopoda has been worked out in numerous instances.[1] To illustrate these, some more or less familiar genera may be taken as characteristic examples.

Lingula has been shown by Hall and Clarke (Pal. N. Y., Vol. VIII, 1892) to have had its inception in the Ordovician. In the ontogeny of both recent and fossil forms, the first shelled stage has a straight hinge line, nearly equal in length to the width of the shell. This stage may be correlated with the more ancient genus *Paterina*, from the lowest Cambrian. Subsequent growth produces a form resembling *Obolella*, a Cambrian and Lower Silurian genus. Then the linguloid type of structure appears at an adolescent period, and is completed at maturity. Thus, *Lingula* has ontogenetic stages corresponding to (1) *Paterina*, (2) *Obolella*, and (3) *Lingula*, of which the first two occur as adult forms in geological formations older than any known *Lingula*.

---

[1] C. E. Beecher. Development of the Brachiopoda. Part I, Introduction. Am. Jour. Sci., Vol. XLI, April, 1891.

Development of the Brachiopoda. Part II, Classification of the Stages of Growth and Decline. Am. Jour. Sci., Vol. XLIV, August, 1892.

Development of Bilobites. Am. Jour. Sci., Vol. XLII, July, 1891.

Revision of the Families of Loop-bearing Brachiopoda. Trans. Conn. Acad. Sci., Vol. IX, May, 1893.

Deslongchamps e. Etudes critiques sur des Brachiopodes Nouveau ou peu connus, 1884.

Fischer and Œhlert. Brachiopodes: Mission Scientifique du Cap Horn, 1882–1883. Bull. Soc. Hist. Nat. d'Autun, vol. v, 1892.

Paterina represents the prototype of the Brachiopods. It shows no separate stages of growth in the shell, is found in the oldest fossiliferous rocks, and corresponds to the embryonic shelled condition (protegulum) of the class.

The genus *Orbiculoidea* of the Discinidæ first appears in the Ordovician and continues through the Mesozoic. The early stages in the ontogeny of an individual are, as in *Lingula*, first a *Paterina* stage, followed by an *Obolella* stage. Then, from the mechanical conditions of growth, a *Schizocrania*-like stage follows, and complete growth results in *Orbiculoidea*.

The elongate form of the shell in *Lingula* as well as in many other genera is determined by the length of the pedicle and freedom of motion. The discinoid, or discoid, form of *Orbiculoidea* and *Discinisca* among the Brachiopods, and *Anomia* among Pelecypods, is determined by the horizontal position of the valves, which are attached to an object of support by a more or less flexible, very short organ, a pedicle or byssus, without calcareous cementation. This mode of growth is characteristic of all the discinoid genera, but as already shown, the early stages of Paleozoic *Orbiculoidea* have straight hinge lines and marginal beaks, and in the adult stages of the shell the beaks are usually subcentral and the growth holoperipheral. This adult discinoid form, which originated and was acquired through the conditions of fixation of the animals, has been accelerated in the recent *Discinisca*, so that it appears in a free swimming larval stage. Thus, a character acquired in adolescent and adult stages of Paleozoic species through the mechanical conditions of growth, appears by acceleration in larval stages of later forms before the assumption of the condition of fixation which first produced this character.

The two chief subfamilies of the Terebratellidæ undergo complicated series of metamorphoses in their brachial structure. Generic characters in this family are generally based upon the form and disposition of the brachia and their supports. The highest genera in one subfamily, which is austral in distribution, pass through stages correlated with the adult structure in the genera *Gwynia*, *Cistella*, *Bouchardia*, *Megerlina*, *Magas*, *Magasella*, and *Terebratella*, and reach their final development in *Magellania* and *Neothyris*. The higher genera in another subfamily, boreal in distribution, pass through metamorphoses correlated with the adult structures of *Gwynia*, *Cistella*, *Platidia*, *Ismenia*, *Mühlfeldtia*, *Terebratalia*, and *Dallina*. The first two stages in both subfamilies are related in the same manner to *Gwynia* and *Cistella*. The subsequent stages are different except the last two, so that the *Magellania* structure is similar in all respects to the *Dallina* structure, and *Terebratella* is like *Terebratalia*. Therefore, *Magellania* and *Terebratella* are respectively the exact morphological equivalents to, or are in exact parallelism with *Dallina* and *Terebratalia*.

The stages of growth of the genera belonging to the two subfamilies Dallininæ and Magellaniinæ are further correlated in the accompanying tables.

The simplest genus, *Gwynia*, as far as known, passes through no brachial metamorphoses, and has the same structure throughout the adolescent period, up to and including the mature condition. In the ontogeny of *Cistella*, the *gwyniform* stage, through acceleration, has become a larval condition. In *Platidia*, the *cistelliform* structure is accelerated to the immature period, and in *Ismenia* (representing an *ismeniform* type of structure in the higher genera), the *gwyniform* and *cistelliform* stages are larval, and the platidiform represents an adolescent condition. Similar comparisons may be made in the other genera. Progressively through each series, the adult structure of any genus forms the last immature stage of the next higher, until the highest member in its ontogeny represents serially, in its stages of growth, all the adult structures, with the larval and immature stages of the simpler genera. It is evident that in the identification of species belonging to the Terebratellidæ, whether recent or fossil, the strict specific characters

Morphogeny from Gwynia to Dallina.

Periods.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.
Larval	gwyniform ?	gwyniform	gwyniform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform
Adolescent	gwyniform	cistelliform	cistelliform	platidiform	platidiform ismeniform	platidiform ismeniform mühlfeldtiform	platidiform ismeniform mühlfeldtiform terebrataliform
Mature	*Gwynia*	*Cistella*	*Platidia*	*Ismenia*	*Mühlfeldtia*	*Terebratalia*	*Dallina*

Morphogeny from Gwynia to Magellania.

Periods.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.
Larval	gwyniform?	gwyniform	gwyniform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform
Adolescent	gwyniform	cistelliform	cistelliform	bouchardiform	bouchardiform megerliniform	bouchardiform megerliniform magadiform	bouchardiform megerliniform magadiform magaselliform	bouchardiform megerliniform magadiform magaselliform terebratelliform
Mature	*Gwynia*	*Cistella*	*Bouchardia*	*Megerlina*	*Magas*	*Magasella*	*Terebratella*	*Magellania*

nust be given first consideration. Species, therefore, must be ased upon surface ornaments, form and color, within certain mits, and genera only upon structural features developed hrough a definite series of changes, the results of which are ermanent in individuals evidently fully adult.

In each line of progression in the Terebratellidæ, the acceleration of the period of reproduction, by the influence of nvironment, threw off genera which did not go through the omplete series of metamorphoses, but are otherwise fully dult, and even may show reversional tendencies due to old ge; so that nearly every stage passed through by the higher enera has a fixed representative in a lower genus. Moreover, he lower genera are not merely equivalent to, or in exact arallelism with, the early stages of the higher, but they xpress a permanent type of structure, as far as these genera re concerned, and after reaching maturity do not show a endency to attain higher phases of development, but thicken he shell and cardinal process, absorb the deltidial plates, and xhibit all the evidences of senility.

Explanation of Plate.

Morphogeny of Magellaniinæ.

The figures in the left hand column, A–H, represent the tages in the ontogeny of the brachial supports in *Magellania*, ne of the highest genera of the family Terebratellidæ. In the ight hand column are shown the adult, permanent, generic tructures, corresponding to the stages of *Magellania*.

Terebratella passes through all the stages from A to G, *Maga-ella* from A to F, and so on, as far as known for each lower enus.

All figures are drawn of approximately the same length, to acilitate comparison, in consequence the younger stages are nuch enlarged.

ig. A.—Early larval brachiopod, without calcified brachial supports, but with circlet of tentacles on lophophore. The *gwyniform* stage.

ig. A1.—*Gwynia capsula* Jeffreys, a morphic equivalent of larval stage, figure A.

Fig. B.—Later stage of A, showing growth of septum and consequent introversion of edge of lophophore. *Cistelliform* stage.

Fig. B1.—*Cistella neapolitana* Scacchi, showing calcification of loop attached to septum, and other adult features. Morphic equivalent of stage B of *Magellania.*

Fig. C.—Third stage of *Magellania,* with small ring on septum. *Bouchardiform* stage.

Fig. Ca.—Side view of same.

Fig. C1.—*Bouchardia rosea* Mawe, adult, showing ring on septum as in C.

Fig. D.—*Megerliniform* stage of *Magellania.*

Fig. Da.—Side view, showing growth of descending branches as prongs on side of septum.

Fig. D1.—*Megerlina lamarckiana* Davidson, adult form of brachial supports.

Fig. E.—*Magadiform* stage of *Magellania,* showing completion of descending branches.

Fig. E1.—*Magas pumilus* Sowerby, the Cretaceous prototype of this structure.

Fig. F.—*Magaselliform* stage, showing union of descending and ascending branches.

Fig. F1.—*Magasella cumingii* Davidson.

Fig. G.—*Terabratelliform* stage, representing the finished type of structure in *Terebratella dorsata.*

Fig. G1.—*Terebratella rubicunda.* Morphically equivalent to G, but showing more mature features.

Fig. H.—Final stage of *Magellania venosa,* produced by resorption of the septum and connecting bands of the *terebratelliform* stage.

Fig. H1.—*Magellania flavescens* Lamarck.

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

By Clarence Bloomfield Moore.

(*Continued from February Number, 1893.*)

(*Third Paper.*)

TICK ISLAND (VOLUSIA COUNTY).

Tick Island can be reached by entering Lake Dexter at its union with the St. John's (see map with the first paper of this series), and continuing across it and along Spring Garden Creek, a distance of about four miles in all, until a landing is reached on the southern side of the creek. The island was entirely unknown in connection with scientific research until visited by the writer in February, March and April, 1891. Other visits were made in January, 1892, January and March, 1893; in all twenty-two days have been devoted to the shell heaps and burial mound on Tick Island, with a large party of assistants; but so interesting is the place, and so extended the remains left by a race now passed from sight that much still awaits a thorough investigation.

In connection with many acres of shell deposit is an interesting burial mound of sand, described by the writer in the American Naturalist, issues of February and July, 1892. Thirty feet south of the great burial mound is a small mound, six feet in height and 180 feet in circumference, composed of fragments of shell mingled with sand, so closely packed that a pick is necessary for the work of excavation. The mound is covered with palmettoes whose roots, closely intertwined, lend an additional difficulty to the work of the explorer. As to the nature of this mound the writer is undecided.

Somewhat over 100 yards distant from the great burial mound in a northeasterly direction is a crescentic, or rather a bean-shaped, shell heap 573 feet in length, with a maximum breadth of base of 233 feet. The height is somewhat irregular, averaging about eight feet from the surrounding level, though the shell deposit is found sunk deep into the marshy soil. Excavations at various points yielded nothing of interest.

SHELL RIDGES, TICK ISLAND.

About a quarter of a mile south of the bean-shaped shell heap lie acres of shell ridges inadequately investigated by the writer. Upon one of these ridges are the remnants of a live oak, now destroyed by fire, but growing at the time of the writer's first visit and then measured by him. Taken at a point five feet from the base the circumference was sixteen feet or twenty-three feet, three feet from the base over projecting knots. At a distance of twelve feet from the trunk of this tree an excavation, 7 ft. by 4 ft., converging to a depth of 9 ft., was made. After 1 ft. 6 in. of humus, shell was reached. From the start fragments of pottery were found in great abundance, the ornamented outnumbering the plain. It was rude and thick in character, made from clay through which vegetable fibre, destroyed in the process of baking, had left minute canals. To overcome a too porous character, it had been, previous to baking, thinly coated with clay on the outside. The clay contained no admixture of pounded shell or of gravel, which is rarely if ever met with in the shell heaps of the St. John's. The manner of ornamentation mainly consisted of straight lines in various combinations as shown. Many pieces in addition had indentations in connection with lines, as figured by Wyman; while the marking of others consisted of series of concentric circles of increasing size.

At a depth of 7 ft. 6 in.—a depth sufficient to clearly prove its contemporary origin with the shell heap—was found a fragment of ornamented pottery, with a turned lip,[1] the only specimen of the sort ever met with by the writer in a shell heap of the St. John's (Fig. 1). Professor Wyman says ("Fresh Water Shell Mounds of the St. John's River, Florida," page, 53): "the mouth of the vase is generally flaring, is seldom contracted; we have seen no instance in which there were signs of a neck, and only one in which there was anything like a turned lip. This was from Bartram's Mound, and was found on the surface where it had been thrown out in digging up an orange tree. The depth of the hole from which it came was such that it must have been superficial, and may have been brought there by the more recent inhabitants. This view is confirmed by the fact that the stamped ornaments were of a different pattern from anything found elsewhere in the mounds, consisting of a series of short parallel ridges instead of squares." Bartram's Mound, or Little Orange Mound, is on the west side of the St. John's, opposite the entrance of Lake Dexter, and is not over five miles distant from Tick Island.

---

[1] By "lip" the writer means a turning out at one point of the upper margin through which fluid may pass, and not a turned rim encircling the pot. Such turned rims are by no means uncommon. It is taken for granted that Professor Wyman meant to express the same idea in the use of the word "lip."

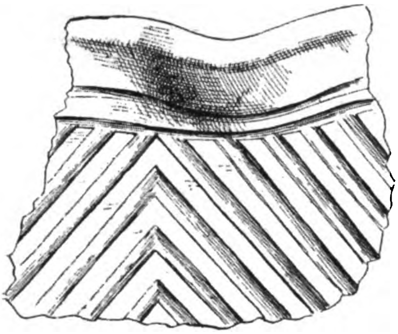
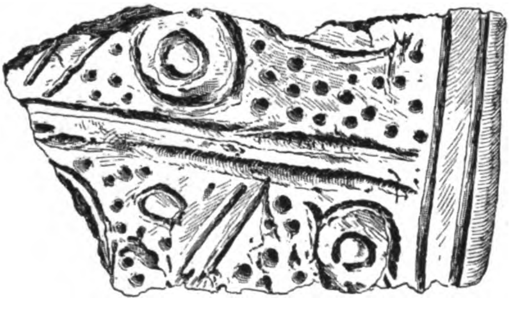


Fig. 1.

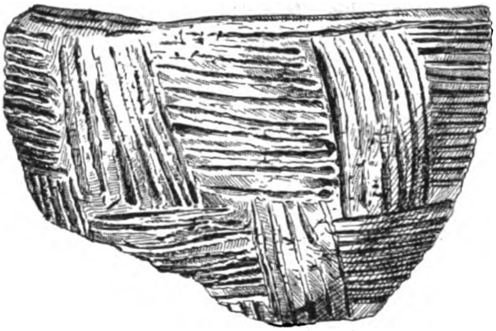
Lipped pottery, Tick Island. (Actual size.)

A number of other excavations, some of larger size, yielded abundant sherds of like quality and pattern. Tick Island and Orange Mound, to which reference will be made later, are

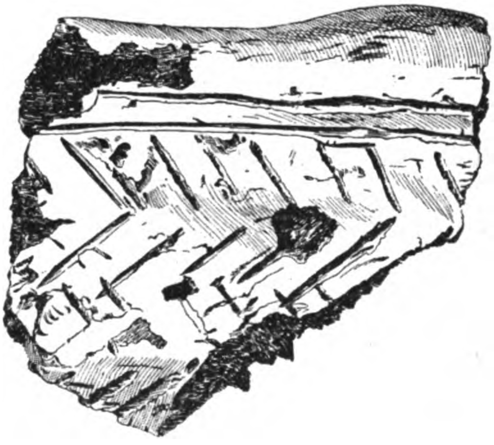


Sherd, Tick Island. (Actual size.)

richer by far in number of sherds and in variety of pattern than any other shell heaps of the St. John's explored by the writer who, it may be said, has not confined himself to localities hitherto unexplored, but has carefully gone over those previously described by Professor Wyman, and has (January, February, March, April, 1893) extensively explored others previously unreported not included in the list given with the first paper of this series.



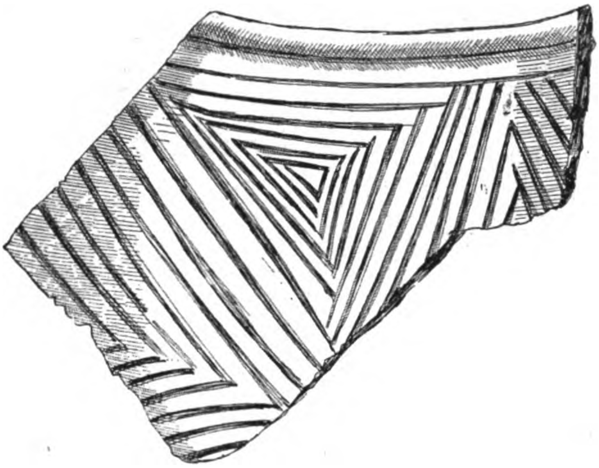
Sherd, Tick Island. (½ size.)



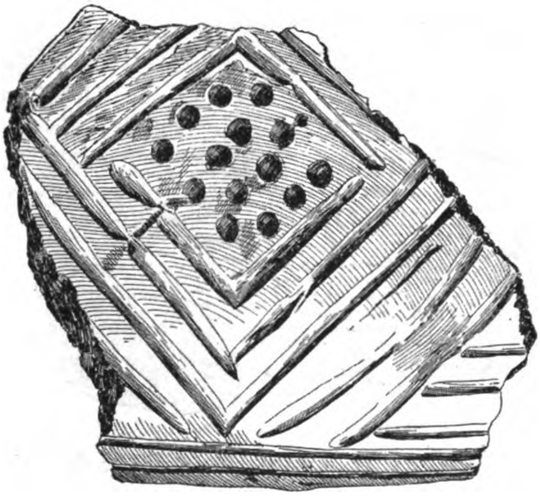
Sherd, Tick Island. (Actual size.)

SHELL HEAP NEAR ECONLOCKHATCHEE CREEK (ORANGE COUNTY).

In the prairie about two miles south of Lake Harney, and nearly a mile distant from the west bank of the St. John's, is a large shell heap covered with palmetto, oak, mulberry and other trees, from many of which hang trailing vines. It looms like an island in the prairie which in wet weather becomes a marsh. By ascending the winding Econlock-

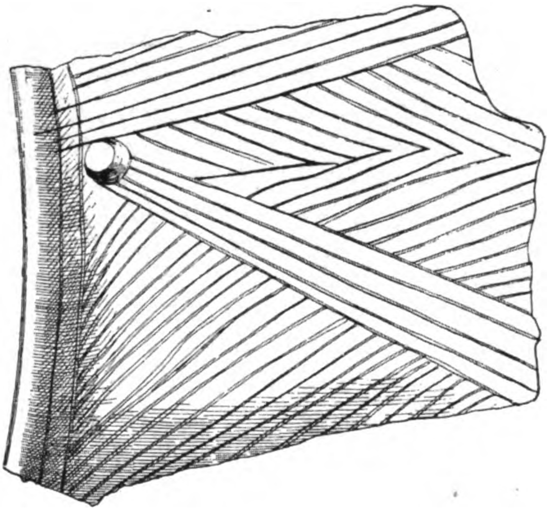


Sherd, Tick Island. (⅜ size.)

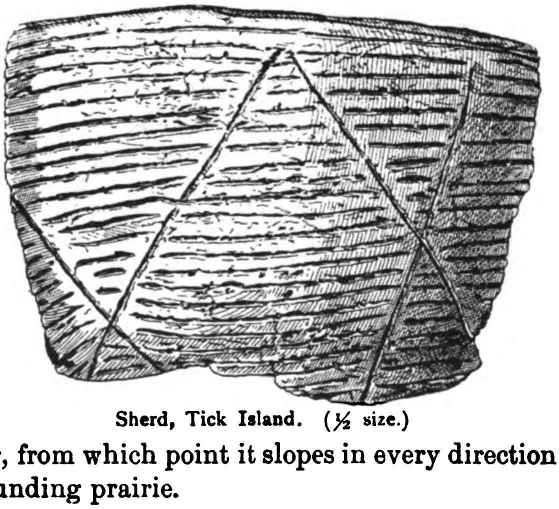


Sherd, Tick Island. (Actual size.)

hatchee, it is possible to tie up within three hundred yards of the shell heap. Its maximum height is about six feet near the center, from which point it slopes in every direction toward the surrounding prairie.



Sherd, Tick Island. (Actual size.)



Sherd, Tick Island. (½ size.)

Excavation I.

At the apex of the mound a hole, slightly converging, 6 ft. by 4 ft. by 7 ft. deep, was dug. Beginning at a level one foot from the surface and continuing through a layer two feet in thickness, were numerous human bones. These bones were broken into fragments and lay at random throughout the entire stratum. Some were found immediately upon a fire-place, and at least one of these human bones showed marks of fire. They were treated in respect to breakage as were the bones of lower animals found with them, and the areas of fracture were of the same dark brown color as the rest of the bone. The bones were so scattered that any estimate as to the number of bodies represented would be impossible, but fragments of at least four crania were met with. Few fragments of bone were in condition for measurement. The average lateral diameter of three portions of tibiæ was 59.9% of the average antero-posterior diameter. As stated in previous papers, these measurements were taken just where the nutrient artery enters the bone. Of three humeri one was perforated.

Composition of the Mound at Point of Excavation.

(*a*) 1 ft.—Sand and powdered shell, containing pottery, plain and ornamented, with fragments of bones of edible animals.

(*b*) 2 ft.—Sand, powdered shell and a slight admixture of shells. Numerous fragments of human bones were found throughout this layer, in association with fragments of animal bones, among which was half the lower jaw of a dog and faeces of animals. At the bottom of this layer, though not covering the entire area, was a fire-place. Absolutely no pottery in this stratum.

(*c*) 1 ft. 6 in.—Ampullariæ, paludinæ and uniones, with slight admixture of sand. No pottery and no bones of animals.

(*d*) 2 ft. 6 in.—Mixture of sand and shell. No remains of any sort.

In the upper layer were found a small piece of chipped chert, a fragment of a rude implement of bone and a rude disc of shell, rough at the margin and perforated in the center, having a diameter of 1¼ inches and a thickness of ¼ inch.

In the Report of the Bureau of Ethnology, 1880–1881, Plate XXVII, fig. 2, an almost exact counterpart of this shell disc is given, with the exception that the perforation is larger and irregular. It is described as one of the stages in the manufacture of shell fish-hooks by the Indians of California; but as fish-hooks of any material are not found in the mounds of the St. John's this disc may be considered a discoidal bead.

A second excavation on the east side of the mound showed, as before, pottery in the upper layer and none in those below. Six fragments of bone were met with, of which two were human.

In this shell heap the hypothesis of burials, even of disconnected bones, would seem untenable, as absolutely nothing found in association with them pointed to interments. A portion of the remains of this probably cannibalistic feast can be seen at the Wagner Free Institute, Philadelphia.

The finding of a bone belonging to the dog is entirely novel in the shell heaps of the St. John's. Professor Wyman's searches yielded no canine remains[2] nor has the writer hitherto upon any other occasion found, to the best of his knowledge, any portion of the skeleton of the dog in the river mounds. Wyman was aware of no evidence to show the presence of domestic dogs on the river in early times,[3] and cites Le Moyne's list of animals supposed to have been seen by the French[4] (1565), from which the dog is omitted. On the other hand, Cabeça de Vaca, Treasurer of the expedition of Pamphilo de Narvaez (1527), found dogs[5] among the natives during his wanderings along the coast of northwestern Florida, and in other portions of his journey. He makes no comment as to their origin, as he doubtless would have done had they been pointed out as curiosities, and it is hardly reasonable to suppose that, at so early a period, their derivation can have been from a European source. The bones of dogs are reported from a shell heap at Tampa.[6] The writer learns however that this discovery was superficial. De Soto, who landed at Tampa, had numerous fierce dogs, and found great quantities of dogs among the Indians of Georgia. Bones supposed to be of the dog are in the stone graves of Tennessee.[7]

---

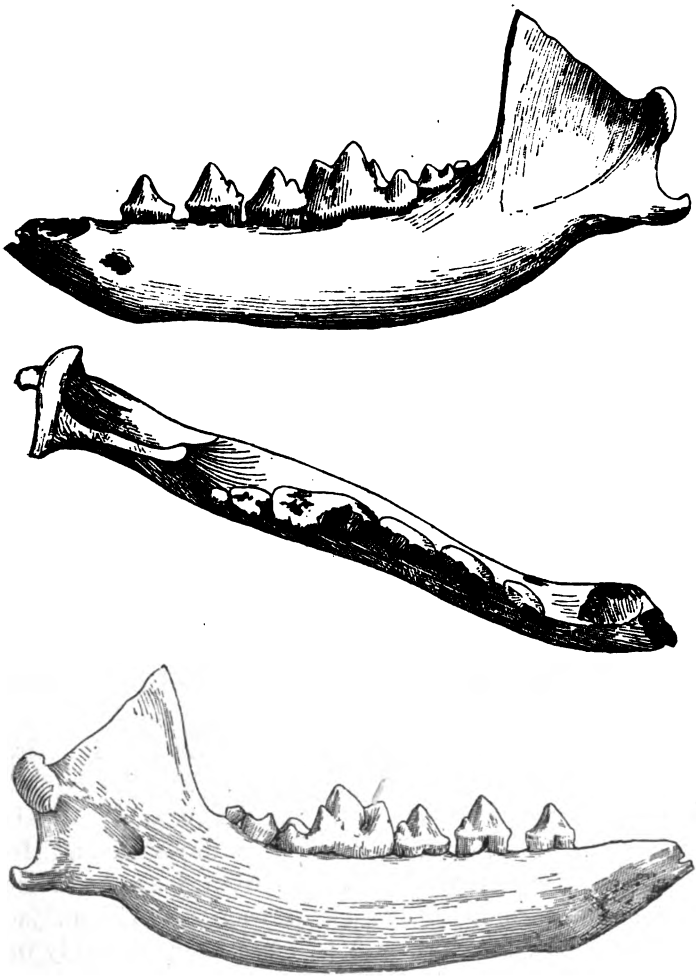
[2] "Fresh Water Shell Mounds of the St. John's River, Florida," page 80.

[3] Loc. cit.

[4] Loc. cit.

[5] "The Narrative of Alvar Nunez Cabeça de Vaca," translated by Buckingham Smith, Washington, 1851, page 41, et al.

[6] "Tampa Sunland and Tribune," Nov. 18, 1876.



Lower jaw of dog from Florida Shell Heap, ¾.

Dr. Dall regards it as presumable that the coyote has been domesticated along our southern border from time immemorial, though perhaps as an occasional curiosity in many tribes, rather than a usual companion. During nine years exploration he found one dog's skull in an Aleutian shell heap, a prehistoric deposit, and only one.[8]

---

[7] Dr. Joseph Jones, "Antiquities of Tennessee," page 9.

The dog has never yet been found fossil in Florida, though the fossil fauna of the state would suggest its presence.[9]

In view of the fact that but a single fragment of a canine skeleton has been found on the river, and that specimen at no great distance from the surface, it may be well, before arriving at any definite conclusion, to await a farther investigation.

Professor Cope has prepared the following note.

"The lower jaw of the dog found by Mr. Moore presents a number of peculiarities. In the first place, its proportions are not those of either the wolf or coyote. In the next place, the fourth premolar is absent and the short diastema which occupies its place is so much shorter than that which would result were the tooth lost from the jaw of most species and varieties of Canis, that it looks as if the absence were normal to the animal, as in the genus Tomarctus. This tooth is sometimes wanting in some domesticated dogs, but the deficiency occurs in dogs with convex foreheads, which are the product of much civilization. In the third place, the metaconid is larger than in the wolf or coyote, and the domesticated dogs generally. Finally the heel of the sectorial is peculiar. The entoconid is more conic than usual, and such crest as it develops does not form the outer wall of the heel, but is directed more inwardly than usual.

These peculiarities are remarkable, and render it desirable that more specimens should be obtained. The jaw is not referable to any domesticated species or race with which I have compared it. I, however, have not seen the skull and dentition of the Spanish terrier, which, from its appearance, I should suppose to have originated from an African jackal allied to *Canis mesomelas*, and to have been probably introduced into Spain by the Moors. Some of these dogs may have been introduced into Florida by the Spainards.—E. D. Cope."

---

[8] Dr. W. H. Dall, private letter.

[9] Cope.

ORANGE MOUND (ORANGE COUNTY).

This interesting mound is reached by turning to the west from the river into a lagoon, and continuing about 500 yards after leaving the channel. In a straight line it is ten miles south of Lake Harney, but so devious is the river that three times that number probably would not be an overestimate of the distance by boat, by which means alone can access to the mound be had. Le Baron (Smithsonian Report, 1882, page 102) refers to Orange Mound. He made no investigations and puts the height at forty feet; probably a misprint for fourteen, its maximum altitude. His other dimensions are likewise faulty.

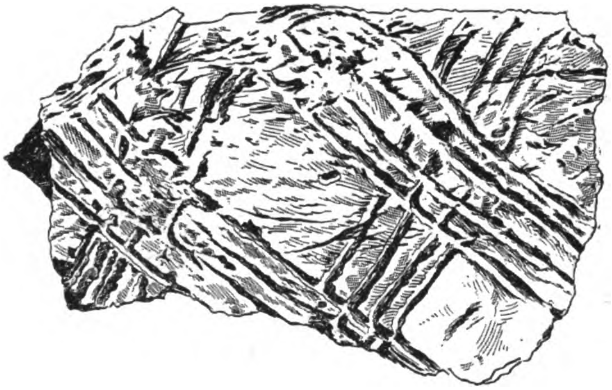
The mound, crescentic in shape, lies north and south. Its length, following the ridge of the crescent, is 560 feet; its maximum width 260 feet. It slopes on every side toward the water and offers usually a secure retreat for numerous large hard-shell turtles which visit it to deposit their eggs. By cutting off their escape to the water, the crew of the writer's boat in one morning secured five, and doubtless the aborigines in the same manner obtained this staple article of diet.

The mound has been under cultivation for the growth of cane, and a tumble-down shed, where once an old caldron stood, is very picturesque, shadowed by towering palmettoes and flanked by a tropical growth of bananas.

Surface pottery is abundant, both plain and stamped in squares. It is of fairly good quality and probably has no connection with the builders of the shell heap. Orange Mound was visited by the writer a number of times during the winter of 1891 and photographs secured; but February 7, 8, 9, 1892 and two days of the winter of 1893 were devoted to serious excavations.

Excavation I.

About the center of the mound at its highest point, 12½ ft. by 8 ft. by 15 ft. deep, converging. The first foot was through a layer of loam filled with pottery of the variety seen on the surface. At a depth of one foot was found a shell chisel, small and perfect. The next three feet consisted of ampullariæ loosely thrown together, with a slight admixture of sand. Many of these shells were of extraordinary size, among them being found specimens far surpassing all previous records known to science. At a depth of 1½ ft. were clearly defined traces of a fire-place. Through the layer of ampullariæ and in the succeeding stratum, consisting of one foot of brown sand, mingled with ampullariæ, unionidæ and paludinæ, pottery was abundant, thick and coarse in character, with a certain percentage decorated with lines.



Sherd, Orange Mound. (Actual size.)

In its method of manufacture, namely, the admixture with the clay of vegetable fibre, which subsequent heat had destroyed, leaving the material porous in character, it resembled the pottery of the shell ridges at Tick Island and of some other deposits of the river, some sherds being so much as .7 inch in thickness. The patterns varied considerably as to the arrangement of lines, and in certain ones decorations appeared on the upper margin of the rim (Fig. 2).

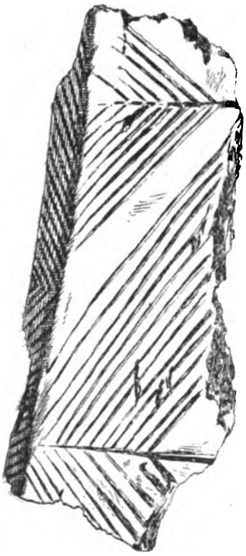
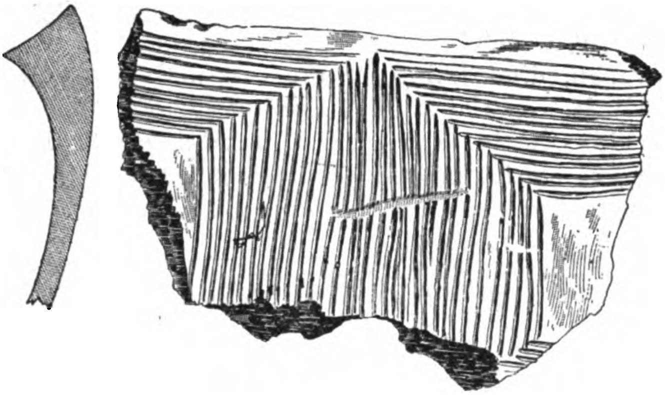


Fig. 2.
Orange Mound. (½ size.)

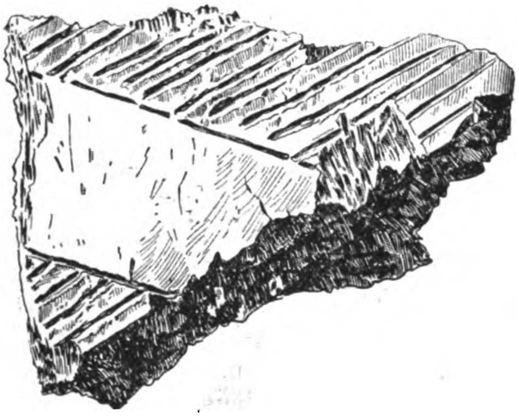
Some fragments with inverted rim were

thickest at the top, the general thickness being .6 inch, thickness of rim 1.2 inches.

At a depth greater than five feet not a fragment of pottery was encountered. Fire-places were found at varying depths, while throughout the entire excavation bones of the turtle, deer, alligator and other edible animals were met with. At a depth of 4½ feet, in a layer of brown sand, with a percentage of shell intermingled, strongly reminding the writer of the brown sand layer in the Tick Island burial mound,[10] a num-



Sherd, Orange Mound. (½ size.)

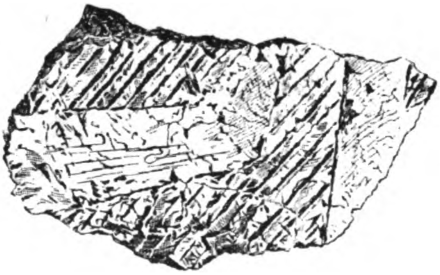


Sherd, Orange Mound. (Actual size.)

---

[10] American Naturalist, February and July, 1892.

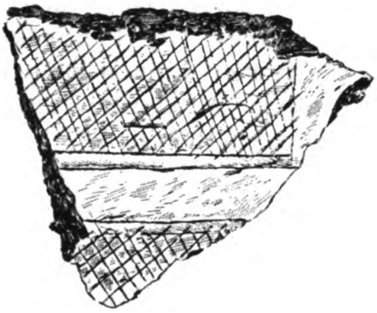
ber of human bones were encountered. They were somewhat disturbed by the digging but were neither crushed nor broken as are the bones of the shell heaps, and it was evident that interments had taken place. Below the bones was a layer of pure white sand, so common in the burial mounds. This stratum seemed to a great extent to be local, being 1½ feet through at the thickest part, namely, the northwest part of the excavation, diminishing on the east and west and being entirely lost on the south. Further investigations showed the white sand layer to decrease in thickness to the north, being but four inches thick at a distance of three feet beyond the excavation.



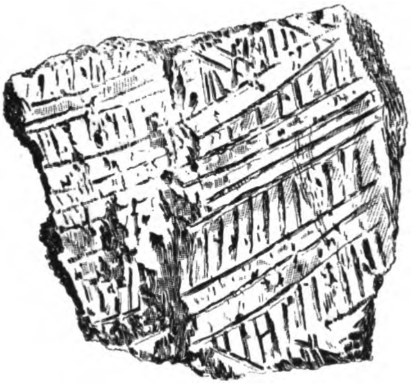
Sherd, Orange Mound. (½ size.)

By digging with trowels into the south side of the excavation, in a layer of almost pure brown sand was found the skeleton of a woman, buried at length in a horizontal position in perfect anatomical order. The skeleton as it lay measured 5 feet, 1½ inches in length. The position of the skull was 10° south of west, the feet pointing 10° north of east. The forearm lay across the pelvis. The body had been buried upon its left side and the left leg and arm were missing. It is almost certain, in view of the presence of every other bone of the skeleton, that these members, extending somewhat from the body, unlike the right arm and leg, were thrown out by the spades prior to troweling into the side of the excavation. The skull was somewhat crushed. The femur was 14½ inches in length (tape); the humerus was not perforated. The tibia in lateral diameter was 58.2% of the fore and aft diameter, showing decided platycnemism.

About one foot south of this burial on a line with the ribs was found what was probably a burial of the kind so well known in some of the sand mounds of the river and of the coast, where the body, previously exposed to the elements, is denuded of flesh before burial. As a rule, the larger bones are placed in a bundle horizontally and are surmounted by the skull. In this case the cranium lay below the bones. Above it in immediate association were the larger bones of the body. The lower jaw lay about six inches from the upper jaw to one side with the teeth turned away. A few vertebræ were beneath the head, while two heel bones were with the bundle. Upright by the skull was a femur belonging to another body. All these bones were badly decayed



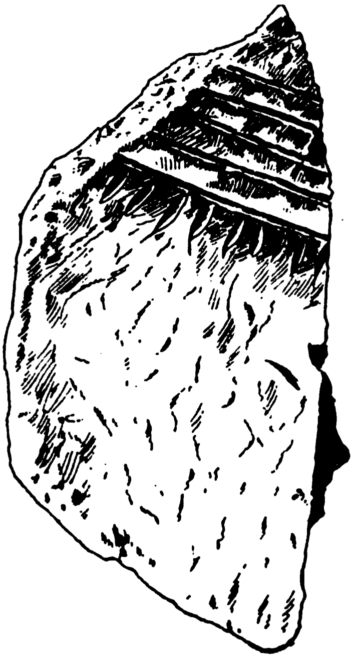
Sherd, Orange Mound. (½ size.)



Sherd, Orange Mound. (½ size.)

being in a far worse condition than those of the skeleton at length.

To return to the main excavation. Below the layer of white sand were two feet of brown sand and shell intermingled, and beneath this was a stratum 2 feet 9 inches in depth composed of crushed shells with a very slight admixture of sand. At a depth of 8 feet were more human bones disarranged by the digging. At a depth of 8½ feet a cranium was found, with bones of the face missing, except a half of the lower jaw. In association were bones of the lower animals. At the same level as the skull, and where they might be looked for, in anatomical order were pelvis, femur, tibia, fibula and foot bones complete. A femur lay somewhat apart. It is possible that this femur, not in association with the pelvis or with the tibia which was found lying across the first tibia in anatomical order, may have been separated from the skeleton by the shifting of sand caused by trampling in earlier stages of the



Sherd, Orange Mound. (Actual size.)

mound.[11] Between the skull and pelvis lay decaying fragments of ribs. It is probable that the missing arm bones extending upward were those inadvertently disarranged by digging half a foot above.

At a depth of 8½ feet immediately below the bones was a layer two feet, nine inches in thickness, consisting of the ordinary crushed shell of the shell heaps, with fire-places, bones of the lower animals, etc., as ordinarily found. Nothing of further interest was met with.

Diagram of the northern side of this excavation is appended.

A number of other excavations were made in various portions of the mound. No pottery was met with below 5½ feet anywhere near the center of the mound, though near the margin—probably a later deposit—pieces were found at a depth of seven feet. Eighty-eight feet from the first excavation on the northern slope of the mound seven feet below the surface was found a portion of a rude spear head of red chalcedony, 1½ inches in length. In this excavation the glandina truncata was comparatively numerous, some thirty or fourty specimens being present. This land shell is of infrequent occurrence in the mounds.

Of the four humeri found during the first excavation not one was perforated. The three tibiæ exhumed in a condition for measurement had an average of 58.0 per cent lateral diameter as compared to the antero-posterior diameter. No crania were saved.

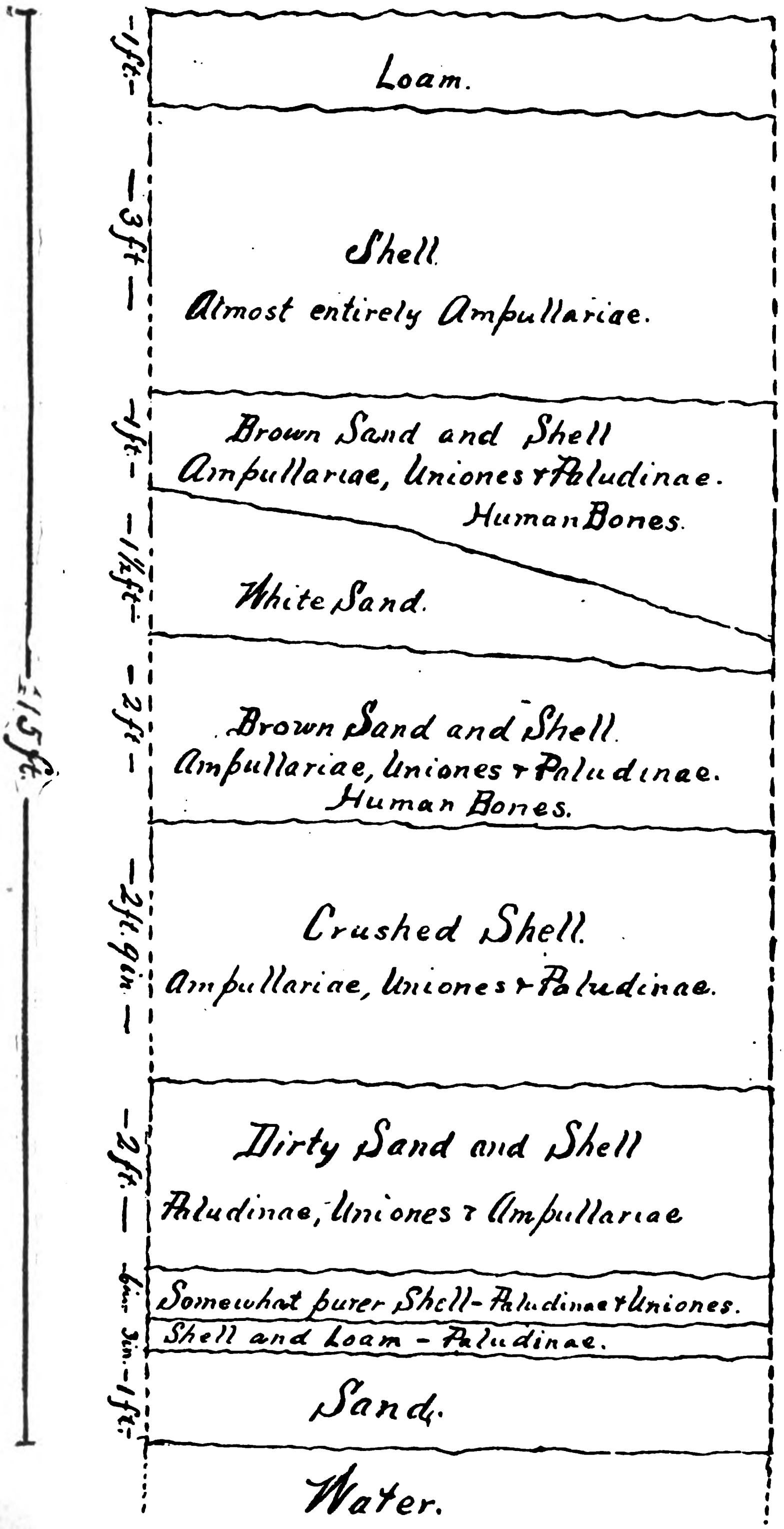
To those interested in the archæology of Florida, the result of the investigation conducted at Orange Mound must be regarded as of considerable importance. It will be remembered that to the present time no conclusive evidence has been secured, assigning to any sand mounds of the river an origin contemporary with the shell-heaps. That burials took place at Orange Mound in a regular stratified mound of sand is beyond the shadow of a doubt, and that the burial mound was not made upon an abandoned shell-heap, perhaps long

---

[11] This shifting of bones is not uncommon according to Topinard, Revue d'Anthropologie, 1886, page 742.

Section of North Side of Excavation. Orange Mou

Scale ½" = 1'.


15 ft.
1 ft.
Loam.
3 ft.
Shell
Almost entirely Ampullariae.
1 ft.
Brown Sand and Shell
Ampullariae, Uniones & Paludinae.
Human Bones.
1½ ft.
White Sand.
2 ft.
Brown Sand and Shell.
Ampullariae, Uniones & Paludinae.
Human Bones.
2 ft. 9 in.
Crushed Shell.
Ampullariae, Uniones & Paludinae.
2 ft.
Dirty Sand and Shell
Paludinae, Uniones & Ampullariae
6 in.
Somewhat purer Shell - Paludinae & Uniones.
3 in.
Shell and Loam - Paludinae.
1 ft.
Sand.
Water.

ter the eaters of shell-fish had passed away, is irrefutably own by the three feet of ampullariæ piled above. It must erefore be admitted that the aborigines of the shell heaps, one instance at least, interred their dead in a sand mound every respect similar to many burial mounds of the St. ohn's, and the writer considers it so unlikely that the strati- ed burial mound met with in the center of the great shell- eap at Orange Mound is an isolated case in respect to the ethod of sepulture of the eaters of shell-fish that at least the rection of some of the sand mounds of the river by the men ho piled up the shell-heaps would seem to be strongly indi- ated.

LONG BLUFF (ORANGE COUNTY).

This bluff on the west bank of the St. John's lies directly n the water's edge. It is separated from a large shell-ham- ock by a quarter of a mile of marsh. This southerly por- on probably is considered a part of the Bluff, or at all events as no distinctive name. Long Bluff, unlike most of the ell-deposits south of Lake Harney, is not composed entirely f shell and does not appear to owe its origin solely to the ebris of the meals of the aborigines, but consists of sand hrough which is a sprinkling of shells. It is perfectly level nd if cleared of the dense mass of palmettoes which shade t, would be termed a shell-field.

A Cache.

About midway in the northern portion of the Bluff an xcavation, the point for which was selected at random, was nade, 1½ feet through the sandy loam, with here and there an ccasional shell. Beneath was a hard conglomerate of sand nd shell, mostly uniones, about four inches in thickness, ecessitating the use of the pick. Underneath the shell layer vas a pure white sand, continuing to water level. At a depth f eight inches in this sand, or 2½ feet beneath the surface, by ood fortune, was found what was probably a cache of one of he earlier Indians. In a space no larger than a man's hat, in actual contact, lay six chisels or scrapers of shell, each of a different size, 8 inches, 4¼ inches, 3 inches, 2¼ inches, 2 inches, 1¾ inches, in length, respectively; one shell gouge; one spiral instrument for cutting or polishing, 6½ inches in length, made from the columella of the fasciolaria; four bone awls; one curved awl of bone, 4 inches in length; one sandstone hone or whetstone; a large number of the smaller bones of edible animals. (See Plate XVI.)

In order to ascertain whether these relics marked the site of a burial, the excavation was continued until a trench, 15 ft. by 4 ft., 3 in. by 3 ft. to 4 ft. deep, was dug. At a depth of 8 inches from the surface an arrow head was found, and during the course of the digging another hone, an oyster shell and several pieces of lined pottery were met with. There were, however, absolutely no indications of a burial. The chisels were perfect, with one exception, the hone showed no marks of use, and the points of the awls were intact. These relics therefore, are not the debris of the shell heaps, and their number precludes the possibility of an unintentional deposit. With no human bones in association, a cache would seem to be indicated, although the presence of unworked animal bones—unless to serve as material for implements—is difficult to explain.

In the southern portion of the Bluff a number of small excavations were made. Fragments of human bone, with broken bones of edible lower animals were met with.

NOTES ON MARINE LABORATORIES OF EUROPE.

BY BASHFORD DEAN.

In every country the Marine Laboratory has become a need the student of biology. During his winter studies in the iversity it serves to provide him with well-preserved mater-, often with living forms which he may himself prepare cording to his wants; in summer it gives him opportunity see and collect his study types and utilize with profit and thout physical discomfort abundant material relating to his idies. To the investigator, the Marine Laboratory has come, in the broadest sense, a university. He may there eet the representative students of far and wide, fellow work-, perhaps, in the very line of his own research, and must mself, unknowingly, teach and learn. He finds out gradu-y of recent work, of technical methods which often happen ost pertinent to his present needs. He may carry on his rk quietly and thoroughly; his works of reference are at nd; he has the most necessary comfort in working—the ling of physical rest, untroubled by the rigid hours of monstrations and lectures.

The importance of the work of the Marine Laboratory has en keenly appreciated in foreign countries, and it is note-rthy how large a number of the original researches is at esent conducted at, or upon material from these distributing nters of biology. At the present day the entire coast line of rope has become dotted with zoological stations great and all, grown out of the resources granted by societies, private lividuals or governments—perhaps by the combined efforts all. It was a matter of great interest to the present writer ring recent visits, to find how thoroughly the Marine Labo-ory system abroad had become a part of every grade of logical work. The student in a small university in the erior of France receives his first lessons from material sent gularly from Roscoff or Banyuls—he examines *living* sponges, droids, lucernarians, pennatulids, beroës, *Loxosoma*, *Coma-*

tula and *Amphioxus.* In Munich, hundreds of miles from the sea, is another example. Professor Richard Hertwig, by the aid of material from Naples, demonstrates the larval characters of ascidians, or the fertilization of the egg of the sea urchin. Every group of European universities seems to have centralized its marine biological work in a convenient locality, and this branch of their needs is supported, and is well-supported, even in countries whose financial resources are most limited. The importance of this work is felt to such a degree that it is not from reasons unselfish that universities have united in their support of a station like that of Naples. This has become literally an emporium, cosmopolitan, bringing together side by side, perhaps not unnaturally, the best workers of many universities whose observations upon the best material, sharpened by discussion and criticism, are certainly tending to become the most accurate and the most fruitful in their direction and results.

It is most singular that foreign countries are unquestioningly liberal in the support of *pure* biology, and in the work of marine stations the tendency is becoming less and less on the part of money-givers to ask how many fish will be hatched to become food material. Public interest has been gradually coming to be directed to the general laws and the problems of life and heredity. This has well been a hopeful sign, and the European biologists are not backward in emphasizing the importance of their studies. Professor de Lacaze-Duthiers does not hesitate even to propitiate the practical Cerberus, reminding him how often 'facts have been found at every step of science which were valueless at their discovery, but which, little by little, fell into line and led to applications of the highest importance—how the observation of the tarnishing of silver or the twitching leg of the frog was the origin of photography and telegraphy—how the purely abstract problem of spontaneous generation gave rise to the antiseptics of surgery.'

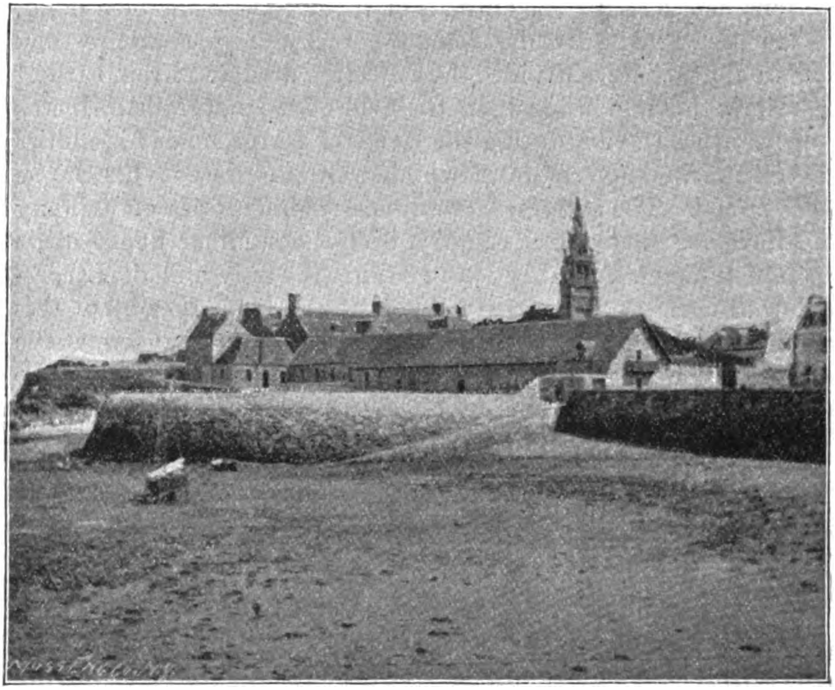
In the present paper it may prove of interest to examine briefly the condition of a few of the biological stations of Europe.

I.—FRANCE.

The extended sea-coast has ever been of the greatest aid to e French student—along the entire northern coast the chanel is not unlike our Bay of Fundy in the way it sweeps the aters out at the lunar tides. The rocks on the coast of Britany, massive bowlders, swept and rounded by the rushing aters, will at these times become exposed to a depth as great s 40 feet. This is the harvest-time of the collector; he is nabled to secure the animals of the deep with his own hand, take them carefully from the rocky crevices where they ould ever have avoided the collecting dredge. From earliest imes this region has been the field of the naturalist. It was ere that Cuvier, during the Reign of Terror, made his studies n marine invertebrates which were to precede his *Règne nimal*. The extreme westernmost promontories of Brittany ave, for the last half century, been the summer homes of de uatrefages, Coste, Audouin, Milne-Edwards and de Lacaze-uthiers. Coste created a laboratory at Concarneau, but this as come to be devoted to practical fish culture, and is, at the resent day, of little scientific interest. It is owing to the xertions of Professor de Lacaze-Duthiers of the Sorbonne, hat the two governmental stations of biology have since een founded. The first was established at Roscoff, in one of he most attractive and favorable collecting regions in rittany, and has continued to grow in importance for the last wenty years. As this station, however, could be serviceable uring summer only, it gave rise to a smaller dependency of he Sorbonne in the southernmost part of France, on the editerranean, at Banyuls, which had the additional advanage of a Mediterranean fauna.

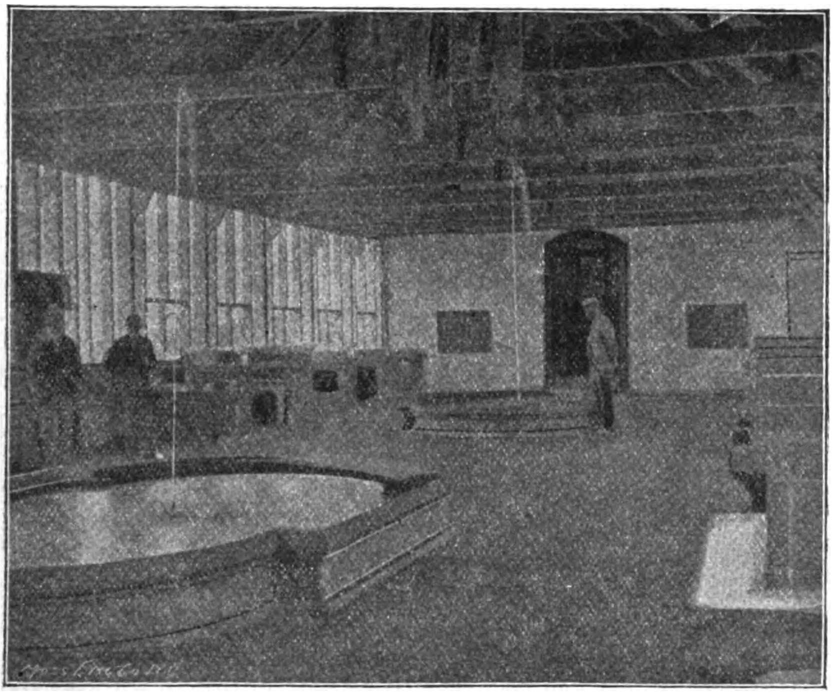
To these French stations should be added that of Professor iard, at Wimereaux near Boulogne, in the rich collecting funel of the Straits of Dover; that of Professor Sabatier at Cette, ot far from Banyuls, a dependency of the University of Montpelier; that of Marseilles and the Russian station at ille-Franche, near the Italian frontier. An interesting staion in addition, is that at Arcachon near Bordeaux, founded by a local scientific society, and having at its command the collecting resources of a small inland sea, famous for its oyster culture. Smaller stations are not wanting, as at the Sables d'Olonne.

At Roscoff the laboratory building looks directly out upon the channel. In its main room on the ground floor, work places are partitioned off for a dozen investigators; this on the one hand leads to a large glass-walled aquarium room, seen in the accompanying figure, while on the other opens directly to adjoining buildings which include lodging quarters, a well-furnished library and a laboratory for elementary students. Surrounding the building is an attractive garden which gives one anything but a just idea of the barrenness of the soil of Brittany. From the sea wall of the laboratory one looks out



FRENCH MARINE STATION AT ROSCOFF, BRITTANY.
(From photograph by author, July, 1891.)

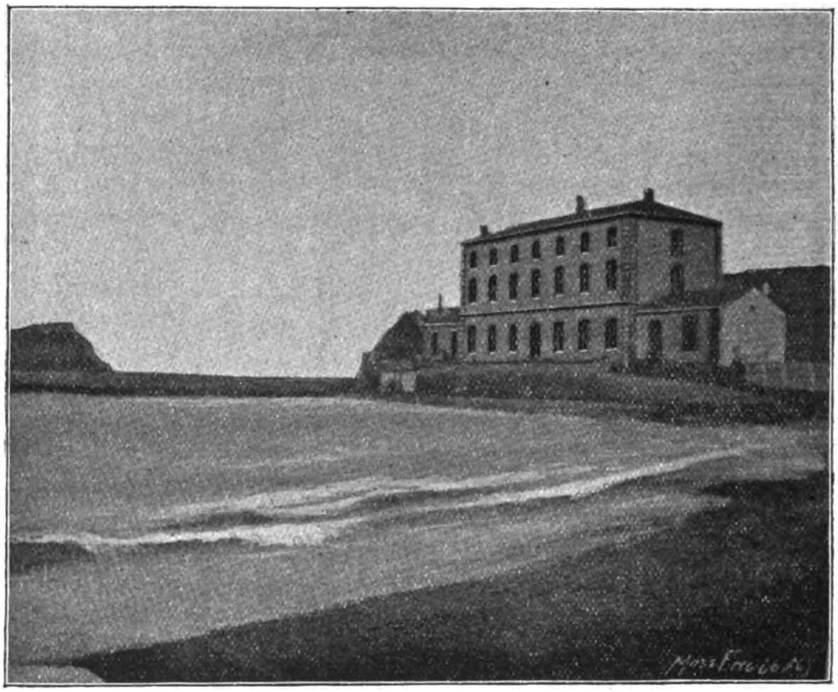
over the rocks that are becoming exposed by the receding tide. A strong enclosure of masonry serves as a *vivier* to be used for experiments as well as to retain water for supplying the laboratory. The students are, in the main, those of the Sorbonne, and are under the direction of Dr. Prouho, their *maitre de conférences*. They are given every opportunity to take part in the collecting excursions, frequently made in the laboratory's small sailing vessels, among the rocky islands of the neighboring coast. Strangers, too, are not infrequent and are generously granted every privilege of the French student. Liberality is one of the characteristic features of Roscoff. The stranger who writes to Professor de Lacaze-Duthiers is accorded a work place which entitles him gratuitously to every privilege of the laboratory—his microscope, his reagents, even his lodging-



ROSCOFF. INTERIOR OF AQUARIUM ROOM.
(July, 1891.)

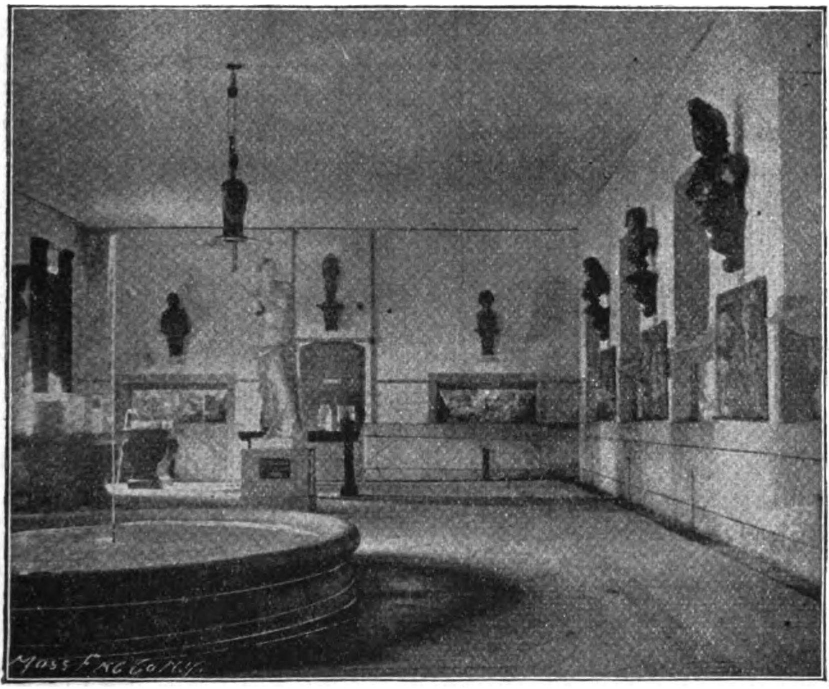
room should a place be vacant. It seems, in fact, to be a point of pride with Professor Lacaze that the stranger shall be welcomed to Roscoff, and upon entering the laboratory for the first time, feel as much at home as if he had been there a week. He finds his table in order, his microscope awaiting him, and the material for which he had written displayed in stately array in the glass jars and dishes of his work place. So, too, he may have been assigned one of the large aquaria in the glass aquarium room—massive stone-base stands, aërated by a constant jet of sea water.

He finds a surprising wealth of material at Roscoff, and his wants are plentifully and promptly supplied.



FRENCH MARINE STATION AT BANYULS-SUR-MER.
(Oct., 1891.)

At Banyuls, the second station of the Sorbonne, the buildings are less imposing than those of Roscoff. It is a plain, three story building facing the north, at the edge of the promontory which shelters the harbor of Banyuls. The vivier is in front of the station, behind is a reservoir cut in the solid rock—receiving the water of the Mediterranean and distributing it throughout the building. On the first floor is a large aquarium room lighted by electricity, well-supplied with tanks and decorated not a little with statuary donated by the Administration of the Beaux-Arts. The bust of Arago occupies an important place, as the laboratory has been named in his honor. The suit of a diver, as may be seen in the adjoining figure, indicates at a glance the different tactics in collecting required by the slightly falling tides of the Mediterranean. The wealth of living forms in the aquaria shows at once by variety of bright colors the richness of southern fauna. Sea



BANYULS-SUR-MER. INTERIOR OF AQUARIUM ROOM.
(Oct., 1891.)

lillies are in profusion, and are gathered at the very steps of the laboratory. The work-rooms of the students are on the second floor, equipped in a manner similar to those of Roscoff. The director of this station is Dr. Frédéric Guitel. It is usual during the holidays at fall or winter, for the entire classes of the Sorbonne to spend several days in collecting trips in the neighborhood. The region, with its little port, is famous for its fisheries, and one in especial is that of the Angler, *Lophius*, a fish that would not be regarded as especially dainty on our side of the Atlantic.

The station on the Straits of Dover, at Wimereaux, has earned a European reputation in the work of Professor Giard. It is but a small frame building, scarcely large enough to include the advanced students selected from the Sorbonne. The laboratory is, in a way, a rival of Roscoff, and it is noteworthy that its workers seem to make a point of studying the laboratory methods of the German universities.

The marine laboratory of Arcachon, one of the oldest of France, was built in 1867 by the local scientific society, and was carried on independently until the time of the losses of the Franco-Prussian War. Its management was then fused with that of the faculty of medicine of Bordeaux, with whose assistance, aided by that of a small subsidy from the government, the work of the institution is carried on. Arcachon, in itself, is a most interesting locality near Bordeaux. It has become a summering place, noted for its pine lands and the broad, sandy *plage*, picturesque in summer with swarms of quaintly dressed children, the local head-dress of the peasant mingling with the latest toilets from Paris. Here and there is to be seen that accompaniment of every French watering place, the goat boy in smock and berret, fluting to his dozen charges who walk in a stately way before him. The Bay of Arcachon is a small, tranquil, inland sea, long known for its rich fauna. In large part it is laid out in oyster parks which constitute to no small degree the source of wealth of the entire region. Shallow and warm waters seem to give the marine life the best conditions for growth and development. The laboratory is placed just at the margin of the water. It includes a dozen or more work places for investigators, well supplied with aquaria, a library on the second floor, a small museum containing collections of local fauna, including numerous relics of Cetaceans that have found their way into this inland sea. A small aquarium room, opened to the public, is well provided with local forms of fishes, and like that of Naples, is eagerly visited. Those who are entitled freely to the use of the work places are instructors in French colleges, members of the Society, and all the advanced students from the colleges of the State. For other students, work place is given upon the payment of a fee whose amount is regulated each year by the trustees. As at Roscoff, material is plentifully supplied.

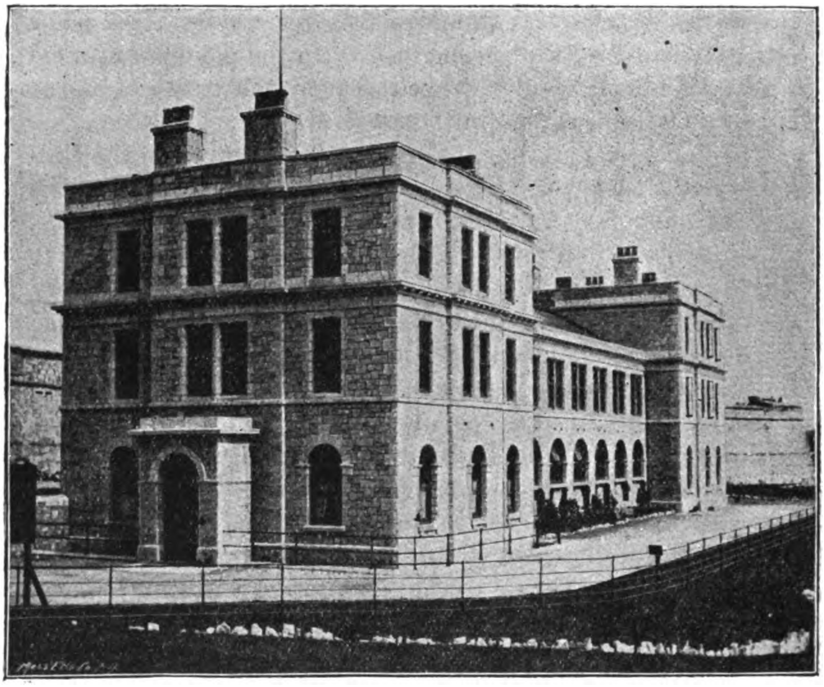
The Zoological Station at Cette is a direct annex of the University of Montpelier, and it has been gladly learned that the present temporary building is to be replaced by one of stone, which will enable Professor Sabatier to add in no little way to the working facilities of his students. The region, in every essential regard, is similar to that of Banyuls.

The station at Marseilles is devoted in great part to questions relating to the Mediterranean fisheries, and owes, in a measure, its financial support to this practical work.

The station at Ville Franche is essentially Russian. An account of this with figures has recently been published (Russian text) in Cracow. The station itself is well known through the work of Dr. Bolles Lee, and it is here that Professor Carl Vogt has been a constant visitor.

II.—England.

The laboratory at Plymouth is quite a recent one, first opened in 1888 with a building which is, in many regards, hardly second to Naples. This locality was found well suited for the needs of an extensive marine station. Opposite Brittany it takes advantage of the same extremes of tide, and the rocky Devonshire coast affords one of the richest collecting grounds. The situation of the building is a remarkable one; it stands at one end of the famous Hoe of Plymouth—a broad, level park whose high situation looks far off over the channel. At the rear of the building are the old fortifications of the town. As shown in the adjoining figure, the building is, at the ends, three storied. On the ground floor is the general aquarium room, well-supplied with local marine fauna, and open to the public. The laboratory proper is upon the second floor, divided into eleven compartments, the work places of the students. A series of small tanks passes down the middle of the room. In the western end are the library, the museum, the chemical, photographic and physiological rooms. In the eastern are the living quarters of the director. The water supply of the laboratory is contained in two small reservoirs directly between the building and the fortifications. Each reservoir contains 50,000 gallons, and the water supply is carried throughout the building by gas engines. Tidal aquaria are in constant use for developmental studies of marine



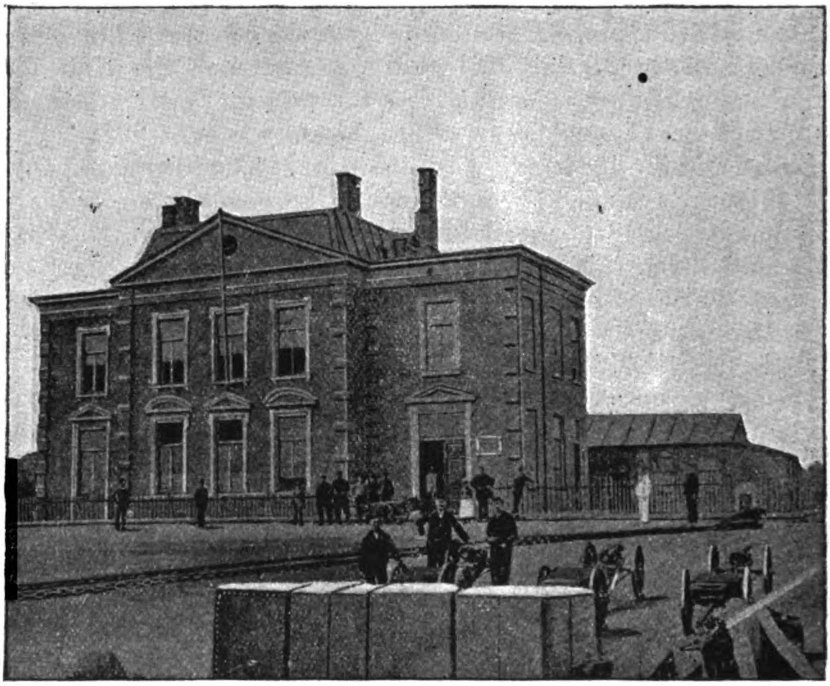
BRITISH MARINE LABORATORY, PLYMOUTH.
(August, 1892.)

ishes. The collecting for the laboratory is aided by a 38-foot team launch.

The present support of the station is not, unfortunately, as generous a one as might be desired. The station is obliged to consider in the work of its director matters relating to public fisheries and is only enabled by this means to secure governmental assistance. The building itself was constructed by the efforts of the Marine Biological Association of the United Kingdom, under whose auspices the present work is being carried on. The efficiency of the laboratory is in no little way hampered in its purely scientific work. The investigators' tables are occupied by any founder of the Association, or his representative, by the naturalist or institutions who have rented them. The subscription price per year of an investigator's place is 40 pounds, but tables may be leased for as short a time as a month. The laboratory provides material for investigation and the ordinary apparatus of the marine laboratory, excluding microscopes and accessories. The use of the larger tanks of the main aquarium is also permitted to the working student. The work of the laboratory includes investigation of fishery matters, the preservation of animals to supply the classes of zoology in the universities and the formation of type collections of the British marine fauna. The naturalist of this station has been, for a number of years, Mr. J. T. Cunningham, whose experiments upon the hatching of the Sole have here been carried on.

Other British marine stations are those of Liverpool and St. Andrews, north-east of Edinburgh. The work of these stations is only in part purely biological; the practical matters of fisheries must be considered to insure financial support. In addition to these there are several stations, notably one south-east of Edinburgh, and another, recently equipped, on the Isle of Man.

At St. Andrews, Professor MacIntosh has studied the questions relating to the hatching and development of the North Sea fishes. Its situation upon the promontory leading into the Firth of Forth seems to have been especially favorable for the study of the North Sea fauna—the locality, moreover, is far enough northward to include a number of boreal forms. The importance of St. Andrews is at length better recognized, and a substantial grant from the government will enable a large and permanent marine station to be here constructed. The facilities for work have, up to the present time, been somewhat primitive—a simple wooden building single storied, has been partitioned off into small rooms, a general laboratory, with work places for half a dozen investigators, a director's room, aquarium and a small out-lying engine house with storage tanks. The laboratory owns a small sail-boat to assist in the work of collecting.



DUTCH ZOOLOGICAL STATION AT THE HELDER.
(Fig. from Tijdschr. d. Ned. Dierk. Vereen, 5 Juli, 1890.)

HOLLAND.

Holland, in the summer of 1890, opened its zoological station in the Helder, a locality which, for this purpose, had long been looked upon with the greatest favor. There is here an old town at the mouth of Zuyder Zee, the naval stronghold of Holland, a station favorable for biological work on account of the rapid running current which renews the waters of the Zee. The station was founded by the support of the Zoological Society of the Netherlands, whose valuable work by the contributions of Hubrecht, Hoek and Horst, has long been known in connection with the development of the oyster industry of Holland. The work of the Society had formerly been carried on by means of a portable zoological station which the investigators caused to be transplanted to different points along the East Schelde, favorable on account of their nearness to the supplies of spawning oysters. The present station at the Helder is situated directly adjoining the great Dyke, a small stone building illustrated in the adjacent figure, two stories, surrounded by a small park. In itself the laboratory is a model one—the rooms are carefully finished and every arrangement has been made to secure working conveniences. A large vestibule leads directly into two laboratory rooms, and by a hallway communicates with the large, well-lighted library, and the rooms of the director. The aquarium room has, for convenience, been placed in a small adjacent building. The director of this station is Professor Hoek, and the President of the Society is Professor Hubrecht. Among others present at the opening of the building may be mentioned, van Bemmelen, Weber, Vosmaer, van Rees, Heinsius, Oudemans and Horst.

EVOLUTION AND DICHROMATISM IN THE GENUS MEGASCOPS.

BY E. M. HASBROUCK.

(*Continued from page* 533, *Vol. XXVII.*)

The accompanying tables show the colors of the young produced by parents of known character as to plumage.[1] It will be readily seen that red birds breed either all red, all gray, or both; that reds and grays breed either all red, all gray, or both; while gray birds, as previously stated, invariably breed true.[2] Now to one at all familiar with the theory of reversion to ancestral characters, the perfect harmony between the two theories is self-evident. Take now, the pigeons, which are descended from a parent of bluish color, with certain bars and other markings, and when any breed assumes by simple variation a bluish tint, these bars and other marks invariably reappear; call the two color phases of the common screech-owl species; call the various breeds of pigeons, some of which have bred true for centuries, species; compare these and how exactly parallel are the two cases.

Lastly: the widely accepted theory of the transmission of acquired characters comes to my assistance. Take, for example, the great similarity at certain periods between the plumages of the various ducks, which would indicate that the common ancestor of the duck family was of a dusky color, or, better still, an example of to-day. The young of the genus *Merula* has the breast spotted as in the genus *Turdus*, while that of the adult is plain. Now, one of the grounds upon which this genus is based is, that were the adults spotted, instead of belonging to the genus *Merula*, they would belong

---

[1] The question mark in the third column signifies that the number of young were not given.

[2] Considerable uncertainty was manifested by some contributors as to what constituted a young, gray bird, they giving the gray down as such, and, while great care has been taken to avoid all such data, it may be well to call attention to possible error.

Table Showing Color of Young Produced by Gray Parents.

NO.	LOCALITY.	NUMBER OF YOUNG.	COLOR.	AUTHORITY.
1	Owego, N. Y.	?	All gray.	J. Alden Loring.
2	Hamilton, Ohio.	?	All gray.	Geo. Harbron.
3	Salineville, Ohio.	4	All gray.	Wm. A. Savage.
4	Sioux City, Ia.	?	All gray.	Dr. Guy C. Rich.
5	Providence, R. I.	5	All gray.	Chas. E. Doe.
6	Racine, Wis.	3	All gray.	Dr. P. R. Hoy.

Table Showing Color of Young Produced by Red Parents.

NO.	LOCALITY.	NUMBER OF YOUNG.	COLOR.	AUTHORITY.
1	Portland, Conn.	5	Red, 3 ; Gray, 2.	Jno. H. Sage.
2	Lockport, N. Y.	1	All red.	J. L. Davidson.
3	Oakdale, N. C.	?	All red.	Robt. J. Thompson.
4	Odin, Ill.	?	All red.	C. B. Vandycook.
5	Rockford, Ill.	6	Red, 4 ; Gray, 2.	J. E. Dickenson.
6	Hamilton, O.	?	All red.	Geo. Harbron.
7	Grinnell, Iowa.	?	All gray.	Lynds Jones.
8	Grinnell, Iowa.	?	All gray.	Lynds Jones.
9	Argentine, Kansas.	3	Red, 2 ; Gray, 1.	Geo. E. Stilwell.
10	Bell, Ky.	6	"Part red, Part gray."	Carrington C. Bacon.
11	Providence, R. I.	2	Red, 1 ; Gray, 1.	H. A. Cash.
12	Beaufort, S. C.	?	Gray, 2 ; Rest red.	Walter Hoxie.
13	Beaufort, S. C.	?	Red, 1 ; Rest gray.	Walter Hoxie.
14	Washington, D. C.	3	All red.	C. W. Richmond.
15	Cambridge, Mass.	3	All red.	Wm. Brewster.
16	Madison, Wis.	4	All red.	Chas. F. Carr.
17	Racine, Wis.	4	All red.	Dr. P. R. Hoy.
18	Jefferson, Wis.	5	Red, 3 ; Gray, 1 ; Intermediate, 1.	Ludwig Kumlien.
19	Charlestown, W. Va.	5	Red, 4 ; Gray, 1.	B. W. Mitchell.

Table Showing Color of Young of Gray and Red Parents.

NO.	LOCALITY.	NUMBER OF YOUNG.	COLOR.	AUTHORITY.
1	Astoria, L. I.	4	All red.	Franklin Bennet.
2	Toronto, Canada.	5	Red, 2; Gray, 3.	James R. Thurston.
3	Argentine, Kansas.	3	Red, 2; Gray, 1.	G. E. Stilwell.
4	Argentine, Kansas.	2	Both red.	G. E. Stilwell.
5	Manhattan, Kansas.	3	All red.	D. E. Lantz.
6	Versailles, Ky.	?	All gray.	L. O. Pindar.
7	Attleborough, Mass.	4	All gray.	H. A. Cash.
8	Cambridge, Mass.	4	All red.	Wm. Brewster.
9	Giddings, Texas.	?	All gray (*mccallii ?*).	J. A. Singley.
10	Strafford, Vt.	?	Red, 2; Remainder gray.	Chas. P. Collins.
11	Fayette, Mo.	4	Gray, 2 (2 died).	J. W. Kilpatrick.
12	Jefferson, Mo.	4	Red, 2; Gray, 2.	Ludwig Kumlein.

to *Turdus;* it being claimed that *Merula* has been evolved fr
and is one plain above *Turdus*, and that the spotted breast of
young robin is a transitory inheritance of the acquired ma
ings of the rest of the thrush family. If this be so, then, as
screech-owls are gray in the down, from which those desti
to be red, *afterwards* acquire their plumage at the first mou
does it not follow that the aboriginal bird was gray, wh
prominent and characteristic markings are reproduced
every brood of young? While on the other hand, if the do
of young birds were *red*, from which the gray birds appea
after the moult, the whole theory would be overturned, bu
is hardly necessary to state that this is not the case; and
fact that gray birds are extremely rare in some regions,
wholly wanting in others, seems conclusive proof that
gray form is gradually becoming extinct over certain area.

He who believes that each variety of pigeon known
fanciers has been independently created, and that the vari
color phases exhibited by individuals of the same species
without meaning and without purpose, will probably as
that each species has been created with a tendency to v
both under nature and under domestication, each in its
particular manner, so as often to become marked like ot
species of the same genus, and that a species has been crea
with a strong tendency to produce young not the color of t
parents, but other forms closely connected. To admit this v
seems, as Darwin aptly says, "To reject a real for
unreal, or at least for an unknown cause. It makes the wo
of God a mere mockery and deception," and "I would aln
as soon believe with the old and ignorant cosmogonists
fossil shells had never lived, but had been created in ston
as to mock the shells living on the seashore." While, on
the other hand, both geology and palæontology plainly
claim that old forms have been supplanted by new
improved forms of life, the product of "variation" and
survival of the fittest.

PART II.

CAUSES AND INFLUENCES.

The close relationship existing between various branches of science, is, perhaps, nowhere more clearly shown than in the present field of research. Four distinct causes have been found appearing to influence the condition of the screech owls, each of which has an evident bearing upon the other, and the whole forms such a chain of evidence that its truth can hardly fail to be apparent.

These causes or influences are—

1. Humidity.
2. Temperature.
3. Acquired characters.
4. Forest areas.

These will be treated separately under their respective headings and in the order given, while a careful examination of the maps will show their bearing upon the distribution of the color phases of the screech-owl.

A.—INFLUENCE OF HUMIDITY.

It has been conclusively shown by Allen[3] that humidity is one of the main influences governing the local variations of color in individuals of the same species, and that the distribution of the light colored races is strictly coincident with the regions of mean minimum rainfall, while the dark forms are confined mainly to regions of mean maximum rainfall. Naturally enough, its effect is greatest during the breeding season, and with the present species the months of March, April, May and June may be considered as the period during which the young would be most under its influence; accordingly, map 3 has been constructed upon the mean of the data for these four months.

The shaded area designates that region where the mean humidity is 70 and over, while localities having less are unshaded. Now it will be seen that to a very great extent the grays are confined to those areas where the humidity is the greatest, while on the other hand the reds are distributed over the less favored parts of the country. Along the Atlantic and Gulf coasts, this humid belt corresponds very closely with the pine belt on map No. 5 (although narrower on the Atlantic slope). Here the distribution of the color phases fails to correspond with either the pine or the humid belt, although it does so perfectly with the temperature zones (see map No. 4), while in the northern part of the United States and in Canada the similarity is very great. Unfortunately, no data exist for the little strip extending down the Alleghanies, but as mountanious regions are, as a rule, exceedingly humid, particularly when heavily wooded, there is little doubt but that when data is collected for this region, it will show a narrow strip reaching from New York State to the neighborhood of eastern Kentucky, when the similarity between color distribution, humidity, temperature and forest areas will be nearly complete.

---

[3] Bull. Mus. Comp. Zool. II, 1871, 240–241.

The whole subject of dichromatism as regards *Megascops*, may be considered a special case of the general subject of darker colored species inhabiting humid areas. The red form can be assumed to be a more highly colored form of the gray, and the same is true of *Megascops* as a whole in which the various subspecies—*floridanus, mccallii, kennicottii, bendirei, maxwelliæ* and *trichopsis*—are representative of the dark and light forms respectively of the humid and arid regions, and in *Megascops asio* proper, the gray may be taken as the form inhabiting humid areas, while the red phase represents the lighter colored forms of the drier region.

B.—INFLUENCE OF TEMPERATURE.

According to Verrill and Allen,[4] the most potent of all influences in the distribution of color is temperature, which, in the case of birds, is greatest during the breeding season, and as in the case of humidity, map No. 4 is based upon the data for the months previously mentioned. Now, by reference to map No. 4, it will be seen that there are three belts or zones of temperature corresponding to the distribution of the red and gray phases of the screech-owl—the one reaching from Charleston, S. C., to entral Texas having a mean temperature of 65° Fahrenheit nd upward for the months mentioned; another on the north, xtending from New Brunswick to Central Dakota, 45° Fahren- eit and *less*, marking the distribution of the gray form, while he intermediate territory lying between the isotherms of 45° nd 65° covers nearly the entire area inhabited by the reds. Just *how* this influence is exerted it is, of course, impossible to ay, but that there is an apparent relation is evident from a omparison of maps 2 and 4, while maps 2, 3, 4 and 5 show hat on the northern and southern borders all influences com- ine to produce the existing conditions.

---

[4] N. A. Fauna, No. 3, p. 26.

In comparing the northern belt, where a *minimum* degree f temperature exists coincident with the gray phase with the outhern, where a *maximum* degree is found also coincident ith the same phase, the question arises—Why, in one portion f the country, is a low temperature and in another a higher emperature conducive to a given phase? and the problem is knotty one. Future investigations may show that some ause or causes, still unknown, exist along the Atlantic coast, ut the probabilities are that humidity is the dominant factor n the subject under discussion.

C.—INFLUENCE OF ACQUIRED CHARACTERS.

In attempting to ascertain the causes influencing the condi- ion of *Megascops*, one of the foremost things to be considered s the peculiar distribution of sex as regards color. Leaving he intermediates out of the discussion, as being an evident ttempt on the part of nature to fashion a form midway etween the two color phases, it will be best to consider only he gray and red.

Out of the total of 3600 birds which furnished data for this aper, 646, scattered over the entire territory, show the follow- ng relation of color to sex. It will be seen that the number of ray males far outnumber the red males, while the number of ed females outnumber the gray females four to one. This is carcely a fair average for the whole, as it must be borne in mind that the numbers cover *all* of the territory inhabited by he three forms—*asio*, *floridanus* and *mccallii*—and conse-

Table Showing Relation of Color to Sex.

(Based on 646 birds scattered over entire area.)

GRAY.		RED.	
Male.	Female.	Male.	Female.
183	73	93	297

quently include the figures from those localities where the red and gray respectively are the only forms known. Now it will be seen that the red birds are much more numerous than the grays—the total number being 390 as against 256 of the gray, and if the influence of the exclusive red and gray regions on this average be considered, the proportion for the mixed areas will be somewhat increased. As a consequence, in that region shown on map 2, where red and gray birds are intermingled, with red in the majority, the reason is at once apparent why red and gray birds, or two red birds, are so often found mated, and so seldom a pair of grays.

Granting now that the red birds are most numerous, does it not follow that the fewer the grays in any given region, and therefore the farther removed each generation of red birds from the parent stock, *in just such ratio will the tendency to revert to ancestral characters decrease?* It has been shown by Darwin[5] that in the struggle for existence, only those forms survive that are best fitted for the existing conditions of life to which they may be exposed, and, as a result, forms unfitted leave few progeny, and eventually become extinct. It will be shown farther on why the gray form is not fitted for those regions in which the red is now so greatly in the majority; accordingly, it becomes evident that where the red males and females already so greatly outnumber the gray, it requires but an indefinite lapse of time for the existence of the latter form to be forever terminated in certain sections.

---

[5] Origin of Species, 69.

D.—INFLUENCE OF FOREST AREAS.

In speaking of the two color phases, the terms "reds" and "grays" have been used, and when applied in their broadest sense, refer to the predominating colors, and consequently to those areas in which either color is in the majority. On map No. 2, the light and dark areas represent respectively the territory in which the red and gray phases predominate. Map No. 5 shows the predominating distribution of the two great divisions of our forest trees—deciduous and coniferous—the lighter shade indicating the region where the conifers are in the majority, and the darker the deciduous. Now, by a comparison of the two, it will be seen that the distribution of the color phases of the screech-owl coincides, to a large extent, with the distribution of the coniferous and deciduous forests. This similarity of distributions between fauna and flora was so striking, that to ascertain whether or not there was any real connection between the two, a similar state of affairs was looked for, and found in the case of the tawny owl (*Strix aluco*) of Europe. This bird furnishes a somewhat parallel case to that of *Megascops*, as in England, where it is stated that the forests are largely deciduous—Yarrell writes[6] that red is the predominating color, while in Scotland, coniferous as a whole, Mr. John A. Harvie-Brown informs me that the reverse is the case.[7] Coniferous forests in the eastern part of the United States have a grayish cast, and the point to be brought forward is that where the general aspect of the forest growth is gray, gray birds are found. As an instance, in the South where the forests are largely bald cypress (*Taxodium distichum*), and covered with a profusion of Spanish moss, the whole country is decidedly gray, and here the gray birds are almost the exclusive form known.

---

[6] History of British Birds, 4th Ed., I, 153.

[7] On the Continent, in Europe, it appears to be a pretty-well established fact that the red birds are females, and the grays males, which is a remarkable state of affairs when compared with existing conditions on the British Isles.

With the screech-owl, of 55 pairs known to have been actually mated, 39 males and 28 females were red, while 27 males and 24 females were gray, showing that *Megascops* is in no way approaching the condition of *Strix*.

There are at least three places on the map where this similarity of distribution is wanting, as, for example, the deciduous region extending from central New York southwestward through Ohio and northern Indiana, where gray birds predominate, also the territory along the Atlantic coast most decidedly coniferous where red birds are found, and the western boundary of the species from north to south, where little or no timber occurs, and when found is mostly deciduous, and where gray is the predominating color. With these exceptions the similarity is remarkable, while the discrepancies are in a measure compensated for by the hygrometric conditions existing in the localities mentioned.

CONCLUSIONS.

From the foregoing it is evident that the red phase is confined mainly to *Megascops asio* (I am speaking of it as a whole), which, on its northern border, merges into the gray phase; that the southern gray belt incompasses *floridanus*, while in eastern Texas the few red specimens of *mccallii* that are known have been taken from the extreme north-eastern portion of its range, which is influenced both by humidity and temperature (see maps). Again this distribution of color corresponds very closely to the life areas—the gray phase of the Florida form in the South occupying a major portion of the Austroriparian; the red phase of *asio* proper conforming very closely to even the outlines of the Carolinian, while the gray phase is equally identical with the Alleghanian.

It is worthy of note that the gray phase of *Megascops asio* is boreal in its affinities, and that where a gray phase of *asio* is found that is not boreal, it is recognized as a subspecies.

Now if *floridanus* (gray) is separable from *asio* just north of it (red), it seems highly probable that *asio* (red) will some day be separated from the gray phase on the north. It has been shown that as regards the two phases of *asio*, certain areas are inhabited exclusively by reds, certain ones exclusively by grays, while still others are inhabited by a mixture of the two, and that three forms (*floridanus* and two color phases of asio proper) inhabit, as a whole, entirely distinct areas. No one will deny that all of the forms of *Megascops* are descended from a common ancestor, and if through climatic or environmental conditions they have become subspecifically differentiated in various localities, I see no reason to doubt that in like manner under the influence of humidity, temperature, acquired character and forest area, which will be felt for countless generations to come, that the species now known as *Megascops asio* will one day be separated into species and subspecies—the former represented by the original gray, and the latter by the more modern red.

RECENT BOOKS AND PAMPHLETS.

AMEGHINO, F.—Repliques aux critiques du Dr. Burmeister sur Quelques Generes de Mammiferes Fossiles. Extr. Boll. Nac. de Ciencias de Cordoba. T. XII, 1892. From the author.

Annual Report of the Postmaster-General of the United States for the Fiscal Year ending June 30, 1892.

ARANZADI, D. T. DE.—Fauna Americana. Madrid, 1892. From the author.

BAUR, G.—Professor Alexander Agassiz on the Origin of the Fauna and Flora of the Galapagos Islands. Extr. Science, March, 1892. From the author.

BECKER, G. F.—Finite Homogeneous Strain, Flow and Rupture of Rocks. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

BOULE, M.—Description de l' *Hyaena brevirostris* du Pliocene de Sainzelles. Extr. Ann. des Sci. Nat. Zool., t. XV, 1893. From the author.

BRIDGE, T. W. AND A. C. HADDON.—Contributions to the Anatomy of Fishes. 2. The Air-Bladders and Weberian Ossicles in the Siluroid Fishes. Extr. Proceeds. Roy. Soc., Vol. LII, 1892. From the authors.

Bulletin No. 91, New Jersey Agri. Coll. Exp. Station.

Bulletin No. 87, North Carolina Agri. Exp. Station, Nov., 1892.

Bulletin of the Psychological Section of the Medico-Legal Society, Jan., 1893.

CARUS, P.—Truth in Fiction. Twelve Tales with a Moral. Chicago, 1893. From the author.

CROSS, W.—The Post-Laramie Beds of Middle Park, Colo. Extr. Proceeds. Colorado Scientific Soc., 1892. From the author.

DEAN, B.—Report on the Present Methods of Oyster Culture in France.——The Physical and Biological Characteristics of the Natural Oyster Grounds of South Carolina. Extrs. Bull. U. S. Fish Commission, 1890. From the author.

DUGES, D. A.—Um Nuevo Ixodideo. Extr. La Naturaleza, Tomo 2, Serie 2. From the author.

DUMBLE, E. T.—Note on the Occurrence of Grahamite in Texas. Extr. Trans. Am. Insti. Mining Engineers, 1892.——Volcanic Dust in Texas.——Source of the Texas Drift. Extrs. Trans. Texas Acad. Sci., 1892. From the author.

FABRINI, E.—Su Alcuni Felini del Pliocene Italiano. Rendiconti della R. Accad. Lincei Estrallo dal Vol. I, 1892. From the author.

FAIRCHILD, H. L.—Proceeds. of the Fourth Summer Meeting of the Am. Geol. Soc. Extr. Bull. Geol. Soc. Am., Vol. IV, 1892. From the Society.

FELIX, J. AND HANS LENK.—Ueber die tektonischen Verhaltnisse der Republik Mexico. Abdruck a. d. Zeitschr. d. Deutsch. geolog. Gesellschaft, Jahrg., 1892. From the authors.

FOSTER, L. S.—The Published Writings of George Newbold Lawrence. Bulletin of the U. S. Natl. Mus., No. 40. From the Smithsonian Institution.

FRANCIS, D. R.—Biennial Message to the Thirty-seventh General Assembly of the State of Missouri. From the author.

FRITSCH, ANT.—Fauna der Gaskohle und der Kalksteine der Permformation Bohmens. Band III, Heft 2. Selachii (Traguairia, Protacanthodes, Acanthodes).

——Actinopterygii (Megalichthys, Trissolepis). Veroffentlicht mit subvention der Kais. Akademie der Wissenschaften in Wien. Prag, 1893. From the author.

Gatschet, A. S.—Bibliographic Notes. Extr. Am. Antiq., Jan., 1893. The Fish in Local Onomatology. Extr. Am. Anthrop. 1892. From the author.

Gilbert, G. K.—Continental Problems. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

Hatcher, J. B.—The Ceratops Beds of Converse Co., Wyoming. Extr. Am. Jour. Sci., 1893. From the author.

Hicks, L. E.—Some Elements of Land Sculpture. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

Hobbs, W. H.—Phases in the Metamorphism of the Schists of Southern Berkshire. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

Keyes, C. R.—A Remarkable Fauna at the Base of the Burlington Limestone in Northeastern Missouri. Extr. Am. Journ. Sci., Vol. XLIV, 1892. From the author.

Macfarlane, J. M.—A Comparison of the Minute Structure of Plant Hybrids with that of their Parents, and its Bearing on Biological Problems. Extr. Trans. Roy. Soc. Edinburgh, Vol. XXXVII, 1892. From the author.

Morgan, T. H.—Spiral Modification of Metamerism. Reprint from the Journ. Morph., Vol. VII, 1892. From the author.

Osborn, H. F. and J. L. Wortman.—Artionyx, a New Genus of Ancylopoda. Extr. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the authors.

Osborn, H. F.—The Ancylopoda, Chalicotherium and Artionyx. Extr. Am. Nat. Feb., 1893. From the author.

Parker, H. W.—The Principles of Rank among Animals. A Paper read before the Victoria Inst., Dec. 5, 1892. From the author.

Proceedings Congrès International d' Archéologie Prehistorique et d' Anthropologie, II ème Session á Moscow, T. I, 1892.

Proceedings Congrès International de Zoologie, Deuxième Session á Moscow. Première Partie, 1892.

Prosser, C. S.—Thickness of the Devonian and Silurian Rocks of Central New York. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

Rhoads, S. N.—Hybridism Exemplified in the Genus Colaptes. Extr. Science, Dec., 1892. From the author.

Riley, C. V.—Directions for Collecting and Preserving Insects. Pt. F. Bull. U. S. Natl. Mus., No. 39. From the Smithsonian Institution.

Romanes, G. J.—Darwin and After Darwin. Chicago, 1892. From the Open Court Pub. Co.

Sclater, W. L.—List of the Batrachia in the Indian Museum. London, 1892. From the Trustees of the Indian Museum.

Scudder, S. H.—The Tropical Faunal Element of our Southern Nymphalinæ systematically treated. Extr. Proceeds. Am. Acad. Arts and Sci., 1892. From the author.

Skinner, H.—Ovipositing in the genus Argynius. Extr. Canadian Entomologist, date not given.

Tettenhamer, Dr. med. E.—Ueber das Vorkommen offener Schlundspalten bei einem menschlichen Embryo. Extr. Münchner medicinische Abhandlungen, 28 Heft., VII Reihe, 1892. From the author.

Townsend, C. H. T.—A Sarcophagial Parasite of *Cimbex americana.* Extr. Entom., date not given.——An Ajoria bred from Limacodes Sp. Extr. Ps June, 1892.

——The North American Genera of Calyptrate Muscidae. Extr. Trans. Am. Soc., Vol. XIX, 1892.

Utschneider, Dr. med A.—Die Lendenerven der Affen und der Mensc Extr. Münchener Medicinische Abhandlungen, 26 Heft, VII Reihe. 1 Heft, From the author.

Van der Veer, A.—The Management of Cancer of the Uterus, complicate Pregnancy, with Report of a Case. Extr. New York Journ. Gynaecology and Ob rics, July, 1892.——Some Considerations in Reference to Uterine Hemorrh Puerperal and Non-Puerperal. Extr. Am. Gyn. Journ., Oct., 1892. From author.

Ward, H. B.—On *Nectonema agile* Verrill. Extr. Bull. Harvard Mus. Co Zool., Vol. XXIII, 1892. From the author.

White, D.—A New Taeniopteroid Fern and its Allies. Extr. Bull. Geol. Soc. Vol. IV, 1893. From the Society.

Whittle, C. L.—Some Dynamic and Metasomatic Phenomena in the Meta phic Conglomerate in the Green Mountains. Extr. Bull. Geol. Soc. Am., Vol. 1893. From the Society.

Wright, G. F.—Reply to Professor Chamberlain's Criticism on Extra-Mor Drift in the Susquehanna, Lehigh and Delaware Valleys.

Wright, H.—Report on Native Birds of Hauturn Island, New Zealand.

RECENT LITERATURE.

A Popular Botany.[1]—This pretty book professes to enable one who has never studied botany to have a "bowing acquaintance" with the common wild flowers, certainly a most laudable undertaking. The author appears to have fallen largely under the baleful influence of the old-fashioned teachers of botany, characterized not inaptly by the line she quotes from Emerson—

> "And all their botany is Latin names"

which may account for the impression she has that a scientific arrangement or even a "key" must be repellant to the amateur, or "bristling with technical terms and outlandish titles." This book is an honest effort to bring some knowledge of plants nearer to the non-botanical man and woman who may have a natural love of the flowers of the wayside and fields.

At the opening of the book are a few pages devoted to the explanation of terms, in which we find what is so common in popular works—that many of the definitions do not define. There is a woful mixing up of physiological with structural definitions, which must prove as troublesome to the amateur who has a horror of technical terms which "bristle," or of titles which are "outlandish." How much help will the reader get from this definition?—"The Stamens are the fertilizing organs of the flower." Some of the definitions are good enough, and will, perhaps, serve their purpose.

The "Flower Descriptions" are grouped under six heads, viz.: White, Yellow, Pink, Red, Blue and Purple, Miscellaneous. This part is pretty well done, and includes descriptions and many good illustrations of the more striking common flowers of the region within one or two hundred miles of New York City. The provincialism of the book is shown in its title, where the flowers of this limited region are called "*our* common wild flowers," and again on page X, where we find the expression, "this side of Chicago," which makes one ask where is "this side?" The title should be changed so as to restrict the book to the New England and Middle States, in which region it will be a useful book for amateurs. The author should remember that there are "common wild flowers" and multitudes of people who admire them in the South, upon the prairies and plains, in the Rocky Mountains, and in the States of the Pacific Coast. "Our common wild flowers" is an expression with a very different meaning in different parts of the country.—CHARLES E. BESSEY.

---

[1] "How to Know the Wild Flowers." A guide to the names, haunts, and habits of our common wild flowers, by Mrs. William Starr Dana; illustrated by Marion Satterlee; small, 8vo, 298 pp. New York: Charles Scribner's Sons, 1893.

Two Text-Books of Physiology.[2]—The State of Indiana has gone into the business of loaning its name as endorsing certain text-books, which are published as the "Indiana State Series." These two books, by Professor Jenkins, now of the Leland Stanford University, belong to the series. Of the advantages and disadvantages of such a course, much might be said; but for this we have no room aside from the remark that in our opinion the disadvantages far outweigh the greatest advantages gained—the publication of the books at reasonable rates, the prices of the two volumes being fixed by law at thirty and sixty cents respectively.

Dr. Jenkins has done his work well in both volumes, the "Advanced" work being the better of the two—the "Primary" being too old in its style for the students for which it is intended. In each work there is a freshness of style and a logical arrangement which please us, and the greatest fault we can find with the work is the insertion of "review questions" which were doubtless demanded by the publishers (we might say parenthetically that Professor Martin's otherwise excellent "Human Body, Briefer Course," is damaged by the same operation.) Especially admirable is the treatment of the use of alcoholic stimulants, narcotics, and the like. There is no lurid description of the drunkard's stomach, no intemperate use of adjectives, but rather a plain, common-sense view of the matter which will be as effective as the more extravagant statements so common in the suppression of intemperance. In short, we regard these books as among the very best for schools of the grammar and high school grades, and can but wish that they might supplant, in other States than Indiana, the trashy works so commonly in use.

Calderwood on Mental Evolution.[3]—This octavo of 350 pages is written with the object of harmonizing the modern doctrine of evolution or physical continuity, with the doctrine of non-continuity of mental evolution, so far as regards man. The author endeavors to show that while the physical structure of man may have been the result of an evolutionary process, his mind presents too great a difference from that of any of the lower animals to permit us to believe in its origin by a similar process. He regards mind properly so-called, as restricted to man, asserting that animals possess "sensible discrimination" only, while man possesses "rational discrimination." He thus defines the latter power.[4] "Negatively, intelligence is non-sensible discrimination, a distinguishing of difference to which sensibility is unequal. Positively, intelligence is discrimination of the meaning of sensible impressions." This kind of intelligence Dr. Calderwood denies to the animals below man. Few or no naturalists familiar with animals will concur in restricting Dr. Calderwood's intelligence as here defined, to man. It is certain that a great many, if not the majority, of animal species "discriminate" to varying degrees, "the meaning of sensible impressions. Had the author desired a more certain criterion of difference between the animal and the human mind, it seems to us that he would have found it more surely in the capacity of the production of the concept, though it does not seem certain that this grade of mental action is entirely restricted to man.

---

[2] O. P. Jenkins. Primary lessons in human physiology. Indianapolis, 1891, pp. 211.
O. P. Jenkins. Advanced lessons in human physiology. Indianapolis, 1891, pp. 318.

[3] Evolution and Man's Place in Nature, by Henry Calderwood, LL.D., Professor of Moral Philosophy in the University of Edinburgh. Macmillan & Co., 1893.

The grade of mental activity displayed by animals can not, however, be excluded from the realm of mind. Indeed, when reduced to its lowest terms, mind appears as sense impressions, and it ceases only with the disappearance of consciousness. Such at least is the comprehensive definition which may be set off in contrast with no mind, or the realm of pure physical energy. Of course such a definition is not acceptable to the advocates of the non-continuity of mental evolution.

In accordance with the latter view, Dr. Calderwood does not admit that intelligence is related to physical structure (p. 178), although many convincing proofs to the contrary can be found in the annals of brain pathology. He regards passion and not intelligence as the active guide in animal evolution. He regards instinct (pp. 179–187) as not intelligence in any form. He closes with an eloquent defense of Christianity, as though the doctrine of the continuous evolution of intelligence conflicted with it.

It seems to us that in making comparisons between the minds of men and animals, we learn most by using the lowest types of man. Comparisons between the latter and the highest types of men are also very instructive. If the continuity of mental evolution has been interrupted, some interruptions during human evolution might be found as well as prior to it.

Dr. Calderwood's book is interesting as showing what can be said on the non-evolutionary side of psychology. There is much of interest in it, but we do not find his reasoning conclusive.—C.

---

[4] P. 151.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Norian Rocks of Canada.—Professor F. D. Adams of McGill College, Canada has published a memoir on the Norian or Upper Laurentian rocks of Canada.[1] This memoir is the result of five seasons' field-work conducted for the Geological Survey of Canada, supplemented by a laboratory investigation of the rocks constituting the Norian series. According to Professor Lawson, two important results of Mr. Adams' work are first, the clear recognition, as plutonic eruptive formations, of rock masses, which, being petrographically and geolographically units, have each an enormous extent. These are the Norian mass, which occupies nearly 1000 square miles; and the Saguenay mass, which is about six times that area. These masses, which may be termed batholites, are characterized by a distinct type of rock known as anorthorite.

The second important result is the immense simplification effected in Archaean geology in the Canadian territory. (Science, May, 1893.)

The Caudal Fin of Ichthyosaurian Reptiles.—In discussing the recent advances in knowledge of the Ichthyosaurian reptiles, Mr. R. Lydekker refers as follows to an important paleontological discovery which confirms Sir Richard Owen's conclusions that the Ichthyosauri possessed a caudal fin.

"From the circumstance that nearly all their skeletons found in the English Lias have a dislocation in the vertebræ of the tail, Sir Richard Owen was led many years ago to the conclusion that the Ichthysaurs were furnished with an expanded fin at the end of the tail, and that the weight of this fin caused the fracture in question. In the present year, there has been discovered in the Lias one of these reptiles, in which the outline of the fleshy parts is completely preserved, and which proves the existence of a caudal fin of still larger dimensions than Owen supposed to be the case. This interesting specimen is described by Dr. Fraas (*Neue Jahrbuch f. Mineralogie,* 1892, pp. 87-90). We already knew that in the paddles the fleshy part was extended much behind the bony skeleton; but the new specimen shows us that, in addition to the tail-fin, the Ichthyosaurs had a triangular fin on the middle of the back, behind which was a crest of horny excrescence compared to those of the crested newt. The tail fin is vertical and nearly symmetrical externally, although the backbone runs downward to terminate in its lower lobe. In this respect the fin has the same general aspect as in the Sharks, except that in the latter the backbone runs into the upper lobe. It shows, indeed, as Dr. Fraas remarks, how closely analagous is the form of Ichthyosaurs to fishes." (Natural Science Vol. I, 1892.)

---

[1] Ueber das Norian oder Ober-Laurentian von Canada. Stuttgart, 1893.

New Fossil Fishes from the Upper Lias.—Continuing his studies of the fossil fish from the Upper Lias of Cement of Vassy of the Youne, M. Sauvage describes and figures three new species; *Leptolepis affinis* Sauvage, *L. antissiodorensis* Sauvage, and *Pholidophorus gaudryi* Sauvage. The first resembles *L. constrictus* Egerton, but differs from that species by having the preopercular strongly striated, a longer body, more numerous vertebræ, and the ventral fins further back. *Polidophorus gaudryi* is very close to *P. bechei* Ag. and *P. onychius* Ag., it has, however, a longer head, and the scales not so elevated and less numerous than either of these species. It may be identical with *P. dorsalis* Ag., but the description of that species is too meager to allow full comparison. (Bull. de la Soc. d'Hist. Nat. d'Autun, 1892.)

Affinities of Ichthyornis.—Dr. R. W. Shufeldt has published a tabular comparison of the anatomical points of *Ichthyornis dispar*, *Rhynchops nigra* and *Sterna macrura* to show that while in some minor characters *Ichthyornis* seems to come nearer the Gulls than it does the Terns, on the whole it possesses more in common with our now existing Rhyncopidæ than with the Sterninæ. This is most apparent in the cranium; in the large skull compared with the rest of the skeleton; and in certain characters in the vertebral chain and pelvis. (Journ. Anat. and Physiol. Vol. XXVII.)

Cretaceous Formations of Mexico.—Mr. R. T. Hill has recently shown that the Mountain Limestone so widely distributed throughout Mexico is the southern continuation of the Comanche Series of Texas, and is therefore of Lower Cretaceous age instead of Upper Cretaceous and Paleozoic, as has been asserted. The author has recognized the three prominent stratigraphic divisions of the Comanche Series in Mexico as in Texas, and is confident that when the whole region is studied more detailed resemblances of horizons will be observed.

The true Upper Cretaceous is characterized by shallow deposits of ferruginous limestones, clays, sand and lignite. The beds occur in the northeastern border States of Chihuahua, Coahuila and Tamaulipas, and are at least 5000 feet thick. The subdivisions of this series are not distinctly differentiated. The Dakota horizon has no true representative, but the Benton shales and clays with the typical *Inoceramus problematicus* and *Scaphites* occur near Juarez and in El Paso, Texas. The chalky beds of the Niobrara sub-epoch are missing, and the whole of the Niobrara. Pierre is apparently represented by thinner ferruginous clays and impure limestones marked by a commingling of the characteristic fauna and the *Exogyra ponderosa* of the Southern States. The Eagle Pass beds, correlated by White with the Fox Hill stage grade into the Laramie, and the latter into the Eo-Lignitic beds of the Southern States, the whole having a unity of littoral lithological features indicating that the Upper Cretaceous and basal Eocene from the Dakota to the Claiborne inclusive was a continuous epoch of sedimentation, without any serious interruption of continuity until toward its close, and deposited at a marine base level now occupied by the eastern masses of the Rocky Mountains and eastern Sierra Madre. (Am. Journ. Sci., Vol. XLV, 1893.)

On a new Musteline from the John Day Miocene.—In striking contrast to the Tertiary formations of Europe, those of North America have yielded but very few mustelines. From the White River beds only the problematical genus, *Buncelunus* Cope, the systematic position of which is quite uncertain, has so far been obtained, and the John Day beds have hitherto yielded no members of the family. For this reason, even scanty fragments are of importance. Among the collections of the Princeton expedition of 1889 is a mandibular ramus containing only $\underline{p2}$ and $\underline{p3}$, but displaying the alveoli of the other teeth, which was found in the John Day beds at Silver Wells, Oregon. It is obvious at the first glance that this jaw cannot be referred to any genus of carnivores hitherto known from the John Day, and though the absence of the characteristic teeth renders the framing of a generic definition very difficult, yet it is possible to so define it as to make identification of other specimens easy.

Parietis gen. nov., Dental formula $C_{\overline{1}}$ $P_{\overline{4}}$ $M_{\overline{3}}$. $\overline{\text{p2 and 3}}$ small very low, but relatively thick, massive, obtusely pointed and with a cingulum around the entire crown; enamel coarsely wrinkled. Molar alveoli decreasing in size from 1st to 3rd; $\overline{m3}$ implanted by a single fang. *P. princeous* sp. nov. Mandible short but thick and heavy, with a larger mental foramen beneath $\underline{p2}$ and a smaller one beneath $\overline{p3}$, $\overline{p1}$ very small and inserted by one root. Size small. Length of molar-premolar series: M. ·032. Length of $\overline{p2}$, ·005: Width of $\overline{p2}$ ·003. Length of alveolus of

$\overline{m1}$ ·007: of $\overline{m2}$ ·005. Depth of jaw beneath $\overline{p3}$ ·010. The character of the premolars suggest those of *Inercytherium*, but *Parietis* was no creodont, the molar alveoli clearly showing the presence of one sectorial and two tubercular molars, and the whole appearance of the specimen is musteline. Of the European genera *Stephanodon* von Meyer, appears to be most like *Parietis* but differs in many particulars, e. g. in having but two lower molars.—W. B. Scott, *Geological Museum, Princeton, N. J.*, May 24, 1893.

The Mammals of the Deep River Beds.—The Tertiary beds of the Deep River, Montana, were discovered by Grinnell and Dana in 1875. These observers recognized two distinct horizons in the formation, which they called respectively "Miocene" and "Pliocene," without attempting a more exact correlation. In 1878, Cope referred the formation to the base of the Loup Fork, but afterward regarded it as a distinct epoch (Ticholeptus beds), intermediate between that formation and the John Day.

The Princeton expedition of 1891 made extensive collections in the Deep River Valley, and the examination of these has brought to light some interesting new forms, upon which the following preliminary notes are founded. A full description, with figures, is in preparation.

The beds contain, as Grinnell and Dana pointed out, two very distinct faunas, the older one of which is equivalent to the John Day, and the newer to the "Ticholeptus beds" of Cope. The lower strata, from a few very small exposures, yielded numerous specimens of the following forms: *Cynodesmus thooides* gen. et. sp. nov.; *Steneofiber montanus* sp. nov.; *Cœnopus* sp.; *Miohippus annectens?* Marsh; *M. anceps?* Marsh; *Mesoreodon chelonyx* gen. et. sp. nov.; *M. intermedius* sp. nov.; *Poëbrotherium* sp.; *Hypertragulus calcaratus* Cope.

The upper beds, from which alone Professor Cope's collections appear to have been obtained, contain a very different fauna. The following list is made from a comparison of Professor Cope's material with that gathered by the Princeton party: *?Canis anceps* sp. nov.; *Chalicotherium* sp.; *Aphelops fossiger* Cope; *Miohippus* sp.; *Anchitherium equinum* sp. nov.; *Desmatippus crenidens* gen. et sp. nov.; *Protohippus sejunctus* Cope; *P. (Merychippus) insignis* Leidy; *Merychyus zygomaticus* Cope; *M. pariogonus* Cope; *Merycochœrus montanus* Cope; *Cyclopidius simus* Cope; *C. emydinus* Cope; *C. incisivus* sp. nov.; *Pithecistes brevifacies* Cope; *P. decedens* Cope; *P. heterodon* Cope; *Protolabis* sp.; *Procamelus* sp.; *Blastomeryx borealis* Cope; *B. antilopinus* sp. nov.; *Mastodon proavus* Cope.

Cynodesmus gen. nov.—Dentition like the microdont forms of *Canis*, but with the skull structure of the more ancient genera. Cerebral hemispheres small, not overlapping the olfactory lobes or cerebellum, with fewer and simpler convolutions than any of the recent *Canidæ*. Post-glenoid foramen concealed or absent.

C. thooides sp. nov.—Dentition microdont; deuterocone of $\underline{\text{p4}}$ relatively large; face short and cranium long; small frontal sinuses present; mandible non-lobate; size medium.

This genus represents the direct canine ancestor which the John Day beds have hitherto failed to yield. Found by O. C. Mortson in the lower strata.

? *Canis anceps* sp. nov.—A fragment of mandible containing $\overline{\text{p4}}$, $\overline{\text{m1}}$ and $\overline{\text{m2}}$ agrees well with *C. brachypus* Cope, except for its smaller size and more slender jaw. The lower sectorial is nearly as long as in that species (as 17 : 19), but the depth of the mandible is much less (as 21 : 30.) The primitive character of the sectorial renders the generic reference uncertain. Upper beds.

Steneofiber montanus sp. nov.—This species is most like the *S.* (*Castor*) *peninsulatus* Cope from the John Day of Oregon, but the upper molars (except $\underline{\text{m3}}$) have but two fossettes, both of which are anterior to the enamel inflection. In the lower molars the antero-posterior diameter of the crown exceeds the transverse. Found by C. C. Jefferson in the lower beds.

The name *Anchitherium* has been much too extensively applied to American equines. The following table will show the generic distinctions in the Miocene forms of this group which appear to be justified by present knowledge.

I. *Teeth brachyodont.*

A. Conules of upper cheek teeth well-marked; posterior transverse crest not reaching the outer wall; external cusps moderately concave or flattened; anterior pillar of lower teeth distinctly marked.

1. No cement present.

a. Incisors without enamel pits *Mesohippus* Marsh.
b. Upper incisors with enamel pits. *Miohippus* Marsh.

2. Cement on cheek teeth.

Posterior transverse crests of upper teeth confluent with the external wall. *Desmatippus* gen. nov.

Conules of upper cheek teeth much reduced, and external cusps deeply concave; posterior transverse crest confluent with outer wall; anterior pillar of lower teeth reduced and on one or more teeth absent. No cement; incisors with pits. *Anchitherium.*

II. *Teeth hypsodont.*

1. Antero-internal cusp of upper teeth confluent with transverse est. *Protohippus* Leidy.

2. Antero-internal cusp separate from transverse crest. *Hipparion* de Christol.

Desmatippus gen. nov.—Molars and premolars short crowned, the lleys more or less filled with a thin deposit of cement. In the upper ries the posterior transverse crest is connected with the outer walls d sends forward a process which extends nearly to the anterior nule. Inner cusps of lower teeth expanded so as to narrow entrances the valleys. Median inner cusps (a, a′ of Rütimeyer) much more dis- ctly separated than in the older genera.

D. crenidens sp. nov.—Posterior transverse crests of upper cheek eth sinuous; limbs elongate and slender; size moderate.

This interesting new equine very satisfactorily fills the gap between *iohippus* and *Protohippus.* The type specimen was found by I. enet in the upper strata of the Deep River.

Anchitherium equinum sp. nov.—Size equal to that of *A. aurelianense,* t with teeth relatively larger; lower incisors without enamel pits; merus with bicipital tubercle and double bicipital groove.

This is the first American species of *Anchitherium* in the restricted nse in which that name is here employed. It was found by Mr. enet in the upper beds.

Mesoreodon gen. nov.—Skull and dentition very much as in the John ay genus *Eporeodon* but with "adaptive" names, the 3d metacarpal ticulating with the trapezoid and excluding the 2d from the magnum.

M. chelonyx sp. nov.—Metapodials rather short and stout, ungual halanges trowel-shaped and pointed.

This is the most abundant animal of the lower beds, and nearly all arts of the skeleton are known. Two very curious features are the resence of a rudimentary clavicle and of an ossified thyroid cartilage f the larynx. The type was found by O. C. Mortson.

M. intermedius.—Metapodials slender and elongate, and ungual halanges like those of *Merychyus.* Lower beds.

Cyclopidius incisivus sp. nov.—Like *C. simus,* but having two small cisors in each premaxillary; the latter bones also of a different shape from those of the former species. Found by R. A. Stevenson in the upper beds.

Blastomeryx antilopinus sp. nov.—Size decidedly smaller than that of *B. borealis* Cope, and ribs of external crescents on upper molars less prominent. Found by O. C. Mortson in the upper beds.

Besides the new forms here enumerated excellent materials were found of species already named, including some nearly complete skeletons, which will be fully described in the memoir now in preparation.

W. B. Scott.

Geological Museum, Princeton, N. J., June 9, 1893.

Conditions of Erosion beneath Deep Glaciers.—Mr. N. S. Shaler has published a paper on the conditions of Erosion beneath deep glaciers, based upon a study of the Boulder Train from Iron Hill, Cumberland, R. I. The author advances an hypothesis of pressure melting to account for unexplained peculiarities of glacial movement, such as sudden variations of a temporary nature in the position of the ice, and the movement of the ice in the direction of the glacial flow over surfaces of slight inclination. It also accounts for the small amount of erosion often traceable in the central parts of a glaciated district, and explains the phenomena exhibited by drumlins or lenticular hills. (Bull. Harv. Mus. Comp. Zool., Vol. XVI, 1893.)

Paleozoic.—Mr. Whiteaves has published a list of 16 gasteropods found in the Trenton limestone of Manitoba, of which, one *Loxonema winnipegense*, is new. The new species is of interest on account of its close similarity to some of the most typical Jurassic species of *Pseudomelania*. (Can. Rec. Sci. April, 1893).—A new fungus, *Incolaria securiformis*, is reported by Mr. H. Herzer. It was found under the bark of a Sigillaria imbedded in the Zoar limestone of Tuscarawas Co., Ohio and represents a new genus. (Am. Geol. June, 1893). A new fern from the Coal Measures of Henry Co., Missouri, is described and figured by Mr. David White in the Bull. Geol. Soc. Amer., 1893 under the name *Tæniopteris missouriensis*. According to the author the new species presents a striking combination of tæniopteroid and alethopteroid characters.

Mesozoic.—Mr. N. H. Darton has defined a thin series of arenaceous deposits lying between the Potomac and Severn formations, to which he gives the name Magothy formation. Its stratigraphic position places it in the early Cretaceous. (Ann. Journ. Sci. 1893). Mr. P. B. Brodie rts the discovery of fossil fish and labyrinthodonts in the Green ty Marls, immediately overlying the Red Marls of the Upper per in Warwickshire. The fish are represented by scales, numerous e and small spines of cestracionts, and the palatal teeth of *Acrodus erinus;* the labyrinthodonts, by fragments of bones only. (Quart. rn. Geol. Soc., May, 1893.)

enozoic.—Mr. Lydekker has described and figured three new aceans:—*Zeuglodon caucasicus* characterized by its small size; *tanistidæ,* represented by an associated series of four cervical, and first dorsal, a lumbar, and a caudal vertebra; *Iniopsis caucasica,* ch has maxillary fossæ of the Inia type. The fossils in question e found in Eocene strata of the Caucasus Mountains. (Proceeds., don, Zool. Soc., Nov., 1892).—Mr. J. S. Diller has published evice to show that the Shasta-Chico series in California and Oregon is result of continuous sedimentation, and that there is a faunal break regon between the Chico and the Tejon. (Bull. Geol. Soc. Am., ., 4, 1893.)

r. E. T. Dumble reports a bed of Volcanic Dust in Texas. Its tigraphic position is in the brown-coal series of the Fayette beds, , if the correlation of these beds be correct, of Miocene age. (Trans. as Acad. Sci., 1892.)

BOTANY.

The Plants of the Bahamas, Jamaica, and Grand Cayman.—Professor A. S. Hitchcock's paper on this subject, which appeared in the Fourth Annual Report of the Missouri Botanical Garden, is very interesting, inasmuch as it not only catalogues a large number of species, but in addition discusses at some length some of the problems connected with insular floras. The following are some of the author's conclusions.

"It would seem to the writer that the ordinary methods of dissemination would account for the flora of the Bahama Islands without calling in the aid of hypotheses founded on ancient land connection. There are probably no more endemic species than would be found if all the islands were at present connected. It seems hardly reasonable to suppose that Watling's, Crooked Island or Inagua have ever been connected with Cuba or any of the other islands, yet the flora of these have about the same relation to Cuba as do the islands of the Bahama bank. From the table it will be seen that the flora comes from the south, that it is essentially Cuban and that this flora has also established itself in the extreme southern part of Florida, where it is found only on the most recent formations. Climatic conditions undoubtedly prevent any great extension to the north, but most of the plants would probably extend further north than they do, were they not brought into competition with an established flora. On the other hand very few plants from the Southern States have found their way to the Bahamas, and those that have are mostly such as are of wide distribution in the Tropics and hence just as probably came from the south as from Florida.

"Again, the facilities for distribution, the ocean currents and the prevailing winds, are from the south to the north. The Gulf Stream not only tends to bring plants from the south but quite effectually prevents any from drifting from Florida to the Bahamas. The current is so strong that the occasional northers would be more than counteracted, while the easterly winds are favored. What is true of the Gulf Stream to the west of the Bahamas is also true of the Equatorial Current to the east. Distribution by birds is apparently of little importance or we should find more plants with pulpy fruits brought from Florida. Maritime plants are easily distributed by currents as their seeds are not injured by the salt water, and furthermore, as stated by Hemsley and Wallace, when cast ashore they find a suitable place for germination, while many other seeds although transported fail to be placed in a favorable situation. I collected several beans of *Gigalobium scandens* on various beaches, but the plant had not gained a foot-hold as its habitat is the dense woods of the larger islands. But the bulk of the flora of the Bahamas is either maritime or such as would, under favorable conditions, be likely to pass through the salt water ordeal successfully. The islands are all low and probably most of the species are found within the influence of the sea."

The Saprolegniaceæ of the United States.—The monograph of the Saprolegniaceæ of the United States, prepared by Dr. J. E. Humphrey, and published by the American Philosophical Society, is a notable contribution to the botany of the lower plants. It occupies eighty-six quarto pages of text, and is illustrated by seven large plates. The author first discusses the group in general, giving much attention to the non-sexual and sexual reproduction, and bringing out many interesting facts. He confirms the statement of DeBary and others that the so-called sexual reproductive organs are morphologically sexual, though not physiologically so in all cases.

The second part of the paper is occupied with descriptions of the genera and species. Seven genera are known to occur within our limits, viz: *Saprolegnia*, with seven species; *Pythiopsis*, with one species; *Achlya*, with eight species; *Aphanomyces*, with two species; *Dictyuchus*, with one species; *Leptomitus*, with one species; *Apodachlya*, with one species. A number of other species are described, of which as yet no specimens have been found in the United States. A bibliography of 110 titles is given, of which but five are by American authors. The plates add much to the usefulness of the paper, and should make the study of these much less difficult than heretofore.

Dr. Humphrey recommends the following method of cultivating these plants. "The most prolific source of supply is water containing green algæ, and the best subsistance is afforded by insects, such as common house-flies or meal-worms. For material, a handful of algæ may be taken from the stream, pond or pool in which they are growing and placed in a collecting bottle or other vessel, which will protect them from drying. In the laboratory, these are placed in a vessel of water from the public or private water supply, and the culture insects are thrown upon its surface. This collection of a mass of algæ without water, except that retained by the mass, reduces the bulk of specimens, which is of importance when they are taken at a distance from the laboratory, and largely excludes aquatic organisms which might make trouble in the cultures; while experience shows that the zoöspores and oöspores of the *Saprolegniaceæ* are carried with the algæ to a large extent. * * * The insects used may be freshly killed, and their chitonous covering should be broken as little as possible; but I have found that for winter cultures, when fresh insects are not readily available, an excellent substitute may be found in dead house-flies, collected in the fall and kept dry and exposed to the air, but protected from dust. Since the dry surfaces of insects are not readily wetted by water, it has proved useful to moisten them, whether fresh or dried, with alcohol, and then soak them in water for a few minutes to remove the alcohol. They will then, when thrown into the culture vessel, sink until their bodies are mostly below the surface, and so present a much larger area to the swimming zoöspores of *Saprolegniaceæ* than if dry and floating largely above the surface."

The publication of this paper will certainly stimulate the more general study of these interesting aquatic fungi.

CHARLES E. BESSEY.

ZOOLOGY.

A Deformity Inherited.—An account is given in a medical journal by Dr. M. L. Holbrook of a case of deformity transmitted through three generations to both sexes. It appeared first in a person named M. B. Wadsworth, born in Connecticut about the year 1800. It consisted in the absence of the three middle metacarpal bones and phalanges of each hand, and also the absence of the three middle corresponding bones, the metatarsal and phalanges of each foot, together, of course, with the absence of the toes and fingers and that part of the foot and hand belonging to these bones. The remaining parts lay nearly side by side like fingers, and the movement was partly from side to side like claws, rather than a grasping movement, like that of a perfect hand. This man was very able bodied, and worked at farming and laying stone wall, and lived to be about sixty years of age. He married, moved to Ohio and being a neighbor of my parents, I knew him well. He had two children, S. and W. with whom I was intimate, and both inherited the deformity. In the oldest one, however, there seemed to be an attempt on the part of nature to restore the missing parts by producing one double finger on each hand, and a foot partly restored, but the restoration was so imperfect as to really make the deformity worse. This son died in early manhood and left no family. The second son, W., was nearly like the father in both hands and feet. He is still living, married, and has had four children. The first is a man, grown and is not deformed. The second, a girl, now about eighteen years old, is as bad as the father. The third, a son, not deformed. The fourth, a daughter, now dead, was like her father.

As to the cause of this strange deformity we have no absolute knowledge. One story current in the family is that the mother of the original case was frightened at a lobster before the child was born. There is another family belief concerning the cause that is worth relating. It is that the mother received a severe nervous shock from a vicious horse, which had chased her with open mouth and tried to get hold of her with his teeth after she had taken refuge under a wagon. The mental shock may have produced an arrest of development in the unborn child. (Herald of Health, Oct., 1892).

Preliminary Note on the Relationship of the Species Usually United under the Generic Name Sebastodes.—On the Pacific coast of temperate North America, a large number of species of viviparous Scorpaenidae are found. They range all the way from tide water to a depth of 1600 feet, from Cerros Island to Alaska. They are most abundant on the coast of California, about 30 species being known from San Diego and a like number from Monterey. In size, they vary from 1 lb. to 30 lbs.

The species have been variously grouped as forming one genus by Jordan & Gilbert, as forming two by Jordan, and as forming four by Gill. Jordan & Gilbert, in their Synopsis, arranged the species known to them according to the greater or less prominence of the spiniferous ridges of the skull. In examining the skulls of a number of them, one of us several years ago, noticed that in a number of species, the parietals meet over the supra-occipitals, while in others they are separated, and the supra-occipital is exposed above for its whole length.

A more recent examination of a larger series of skulls, tended to show that, if we admit the relationships pointed out by Jordan & Gilbert, this greater or less development of the parietals is of no significance. A more thorough study has, however, convinced us that the species with united parietals are related and that the relationships pointed out by Jordan & Gilbert are at fault.

The value placed on such a cranial character as the union or non-union of the parietals need not be defended here. It may only be mentioned that in *mystinus* which for other reasons we considered the hub to which the other groups proposed here are related as spokes, the parietals are united in 8 out of 10 specimens. The variation of this character in *mystinus* but confirmed our view that it is the radiating point.

Leaving the parietals, the next prominent characters are the development or non-development of certain cranial spines and ridges. These spines are found in all stages from minute points to comparatively huge spines. The variation in size for this reason, if there were no other objections, cannot be utilized for determining generic relationship. The spines are very regularly arranged and in any given species certain ones are always present. (Individual variations should of course be expected in this character as in every other if a sufficient number of specimens are examined). The *constancy* of the presence of certain spines in a given species warrants the use of the presence or absence of these spines in the different species in determining their true relationship. This relationship is usually borne out by a number of subsidiary characters. Considering the constancy of the spines, reinforced by subsidiary characters, we have divided the species usually united under the generic name *Sebastodes* as follows:—

a. Parietals meeting above the supra-occipital.

b. Jaws equal; head narrow above; high and prominent cranial ridges ending in spines; preocular, supraocular, tympanic and parietals present. Scales usually very strongly ctenoid; accessory scales numerous; suborbital stay directed obliquely downward and backward; second anal spine much heavier than, and at least as long as the third; body short and deep, back arched; mouth very large; head heavy. All known species with cross bands.

SEBASTICHTHYS Gill.

*nigrocinctus, serriceps, rubrivinctus, diploproa.**

bb. Lower jaw much projecting; head broad, the skull usually convex; cranial ridges when present low; gill-rakers very long and slender; scales usually smooth, few if any accessory scales. Suborbital stay little if at all oblique.

c. Parietal ridges ending in spines; preocular, supraocular and tympanic spines well developed. Peritoneum black.

d. Postocular spine present. Second anal spine usually stronger and longer than third. Symphyseal knob strong, projecting forward. Dorsal low. (Peritoneum black, mandibles and maxillary scaled.)

ACUTOMENTUM[1] E & B.

melanostomus, ovalis, rufus, **alutus, macdonaldi* n. sp. nov.= *S. proriger* E. & G. not of J. & G.

dd. Postocular spine not developed.

We have not been able to examine the two species (entomelas and atrovirens) and cannot vouch for their position.

cc. Parietal ridges not ending in spines.

e. Preocular spines well developed. Supraocular and tympanic spines sometimes present. Interorbital wide, convex. Peritoneum black. Approximated edges of sub-opercle and inter-opercle frequently ending in spines. PRIMOSPINA[2] E. & B.

The only species (*mystinus*) is the most variable species of the group.

[1] Type *A. ovalis* (Ayres).

[2] Type *P. mystinus* (J. & G).

ee. Preocular without spine, skull smooth, without spines. Peritoneum usually white

SEBASTOSOMUS Gill.

flavidus, serranoides, melanops, **ciliatus.*

aa. Parietals separated by the supra-occipital.

f. Cranium with parietal ridges only. Lower jaw much projecting, entering the profile; a prominent symphyseal knob directed forward. Head broad, convex. Interobital convex, nearly smooth.

SEBASTODES Gill.

paucispinis, goodei.

*Species marked with an asterisk have not been examined in reference to the characters utilized.

ff. Cranium with many ridges, all ending in spines.

g. Postocular and tympanic spines both present. Interopercle and subopercle without spines. Lower pectoral rays normal.

h. Coronal spines; nuchal spines, a spine below, another in front of eye. * *matzubarae* with this species we are not acquainted.

hh. No coronal spines SEBASTOMUS Gill.

*miniatus, pinniger, levis, aereus**, *constellatus, umbrosus**, *rosaceus, rhodochloris**, *gilli**, *rupestris**, *eos, chlorostictus**, *ruber** *rufus.*

gg. Postocular spine wanting.

i. Coronal spines none.

PTEROPODUS E. & B.[1]

Species with normal pectoral rays, (living off the bottom) *saxicola**, *proriger*† *, *brevispinis**, *elongatus, sinensis.*

Species with lower pectoral rays thick (living on the bottom) *zacentrus**, *maliger, caurinus, vexillaris, rastrelliger, nebulosus, carnatus, chrysomelas.*

ii. Coronal spines present.

AUCTOSPINA E. & B.[2]

*aurora**, *auriculatus.*

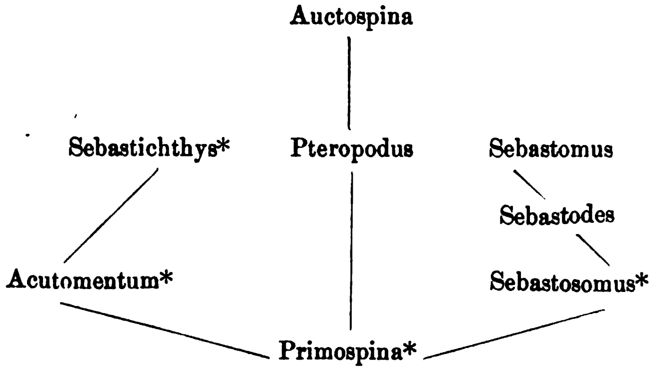
† The specimen described by E. & E., Proc. Cal. Acad. Sci. (2) III, 15, 1890, is a species distinct from *proriger.*

The inter-relationship of these genera is complex. It may be represented by the following diagram where the genera with the united parietals are followed by an asterisk.

---

[1] Type *P. maliger* (J. & G).

[2] Type *A. auriculatus* (Girard).



A revision of the Pacific Scorpaenidæ will be included in my "Viviparous fishes of the Pacific Coast."—C. H. EIGENMANN and C. H. BEESON.

Batrachians of British India.—The total number of Batrachians known at the present time from British India, including the Malay peninsula, comprises 147 species; of these, the Indian Museum possesses specimens of 103 distributed as follows; Ecaudata 99, Caudata 1, Apoda 3. (Sclater's List of Batrachians of the Indian Museum, 1892).

Washington and British Columbian Orinthology.—A resumé of the birds observed in British Columbia and Washington during the spring and summer 1892, is given by Mr. S. N. Rhoads in the Proceeds. Phila. Acad., 1893. To the combined lists of Mr. Chapman and Mr. Fannin, the author adds 21 species that came under his own observation, making the list of species now known from that region number 326. Descriptions of 11 new species observed appear in the Auk for January, 1893. Four specimens of a new variety of *Parus hudsonicus* were obtained in British Columbia, near Field. The new form, *P. hudsonicus columbianus*, is larger and darker than *hudsonicus*, with a much larger bill, and with the throat patch jet black instead of brownish-black.

Zoological News. Hemichorda.—Prof. W. E. Ritter presents in Zoe[3] a popular study of Balanoglossus in which few new facts concerning the larvæ are brought out. Professor Ritter puts in a request for evidence of the existence of Balanoglossus on the Pacific coast.

[3] Zoe iii, 187, 1892.

Fishes.—Evermann has revised[4] the North American Suckers of the genus Pantosteus and recognizes the species *plebeius*, *virescens*, *generosus*, *discobolus* and a new species *jordani* from the upper Missouri Basin.

Reptiles and Batrachia.—Cope catalogues[5] eight species of Batrachia, 5 of turtles, 8 of lizards and 13 of snakes collected in northwestern Texas. The region appears to be interesting as the meeting ground for several geographical districts. The absence of Sceleporus from the collections is due to the absence of timber.

Davenport records the persistence[6] of the right root of the subvertebral artery in an alligator 28 cm. long, and figures two cases of the persistence of the ductus botalli in the same animal.

Mammalia.—At a meeting of the London Zoological Society, M. Tegetmeier exhibited the feet of some Australian rabbits to show an adaptation which is gradually being brought about to a new mode of locomotion. The rabbits are becoming climbers, and often ascend trees in their search for food; their feet are growing slighter and the claws longer and sharper. (Revue Scientifique, Mar. 1893.)—Mr. G. S. Miller reports that *Zapus insignis*, hitherto known only from New Brunswick and Nova Scotia, is locally common in the eastern United States. As the original description was based on three specimens faded by grease and age, he redescribes the species in the Proceeds. Biol. Soc. Washington, April, 1893.

Notes on the Classification of the Cryptodira.—In the June number of the AMERICAN NATURALIST, 1890, I have given a classification of the Testudinata, distinguishing four sub-orders—*Amphichelydia, Pleurodira, Cryptodira, Trionychia.*

To-day I shall give a more detailed classification of the living forms of the Testudinata belonging to the Cryptodira.

CRYPTODIRA.

No free nasals, a parieto-squamosal arch present or absent; descending processes of prefrontals connected with vomer; stapes in an open groove, of the quadrate or covered by the quadrate behind; pterygoids narrow in the middle, without wing-like lateral expansions, separating quadrate and basisphenoid; epipterygoid free or not free; dentary bones united. Cervical vertebræ with rudimentary transverse processes in front of vertebra; the posterior cervicals with double articular faces; sacral ribs well-developed and connected with centrum and neuroids. Pelvis free from plastron and carapace. Epiplastra in contact with hyoplastra; entoplastron oval, rhomboidal or T-shaped, a more or less complete series of peripheralia more or less connected with the ribs.

---

[4] Bull. U. S. Fish Comm. 1892, p. 51, 1893.

[5] Proc. Phila. Acad. 1892, p. 331.

[6] Bull. Mus. Comp. Zoology xxiv, no. 2, 1893.

I.—CHELONIOIDEA.

A parieto-squamosal arch; no foramen palatinum between palate and maxillary; articular faces between the sixth and seventh cervical plane; nuchal with a distinct process on the lower side for the articulation with the neuroid of the eighth cervical; no lateral processes of nuchal. One biconvex cervical vertebra.

1. *Cheloniidæ.*

Skull with descending processes of parietals; limbs paddle-shaped; claws one or two. *Chelonia, Thalassochelys, Caretta, Lepidochelys.*

2. *Dermochelyidæ.*

Skull without descending processes of parietals; limbs paddle-shaped; no claws. Bony carapace dissolved into numerous mosaic-like pieces. *Dermochelys.*

II.—CHELYDROIDEA.

No parieto-squamosal arch; a foramen palatinum between palate and maxillary; articular faces between the sixth and seventh cervicals not plane; nuchal without lower process, but with more or less strong lateral process underlying the peripherals; one biconvex cervical; a complete series of inframarginals.[1]

1. *Dermatemydidæ.*

Frontals not excluded from orbit; maxillary without connection with quadratojugal; squamosal without connection with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 11; an entoplastron. Number of neuralia incomplete; the posterior pleurals not meeting in median line. *Dermatemys.*

2. *Chelydridæ.*

Frontals excluded from orbit; maxillary without connection with quadratojugal; squamosal in connection with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 11; an entoplastron. Number of neuralia complete; posterior pleurals meeting in median line. *Chelydra, Macrochelys.*

---

[1] Some species of *Kinosternon* excepted.

3. *Staurotypidæ.*

Frontals excluded from orbit; maxillary in connection with quadratojugal; squamosal without connection with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 10; an entoplastron; number of neuralia incomplete; posterior pleurals meeting on median line. *Staurotypus, Claudius.*[1]

4. *Kinosternidæ.*

Frontals excluded from orbit; maxillary in connection with quadratojugal; squamosal without connection with postfronto-orbital; mesogastroid reduced; number of peripherals 10; no entoplastron; number of neuralia incomplete; posterior pleurals meeting on median line. *Kinosternon, Aromochelys, Goniochelys.*

III.—PLATYSTERNOIDEA.

No parieto-squamosal arch; a foramen palatinum between palate and maxillary; articular faces between sixth and seventh cervical not plane; nuchal without lower and without a lateral process; two biconvex cervicals; a complete series of inframarginals. Skull of the type of the Chelydroideae.

Platysternidæ.

Frontals excluded from orbit; maxillary in connection with quadratojugal; jugal excluded from orbit; squamosal connected with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 11; an entoplastron; number of neuralia complete. *Platysternum.*

---

[1] In *Claudius* the post-orbital arch is exceedingly slender; the parietal sends down a process behind the postfronto orbital to join the jugal. The zygomatic arch is also very slender, but three times as broad as the postorbital; the interorbital arch is one and a half times the diameter of the orbit. The lower jaw is strongly hooked, with the symphysis larger than the diameter of orbit. Upper jaw with a small but distinct hook, each maxillary with a very sharp lateral hook. Lower side of skull as in Kinosternon; palate not forming a part of the alveolar surface, the posterior nares not bridged over by palate and vomer as in Staurotypus. Pterygoids without any ectopterygoid process.

IV.—TESTUDINOIDEA.

No parietosquamosal arch; a foramen palatinum between palate d maxillary; articular faces between sixth and seventh cervical not ane; nuchal without lower process; two biconvex cervicals; an complete series of inframarginals; squamosal not connected with stfronto-orbital.

Emydidæ.

Quadrate open behind; number of phalanges of second and third e of hind foot more than two; peripherals of bridge without median ocesses interlocking with rib-ends; rib-ends in a groove of the peri- erals.

Testudinidæ.

Quadrate closed behind; number of phalanges of second and third e of hind foot never more than two; peripherals of bridge with med- n processes interlocking with rib-ends.

—G. BAUR, *University of Chicago.*

Two New Species of North American Testudinata.— he following species of Graptemys have been described:

1. *Graptemys geographica*, Les. 1817.
2. *Graptemys pseudogeographica* (Les. MSS.), Holbrook, 1842.
3. *Graptemys oculifera*, Baur, 1890. Science, No. 405, pp. 262–263.
4. *Graptemys kohnii*, Baur, 1890. l. c.

GRAPTEMYS PULCHRA spec. nov.

For some years I have been acquainted with two specimens of a *raptemys* preserved at the Smithsonian Institution. Both specimens ere collected by Dr. T. H. Bean in Montgomery, Ala., and bear the umber 8808. One of these is mentioned in Yarrow's Catalogue Bull. U. S. Nat. Mus., No. 24, 1883), as "*Malacoclemmys geographicus.*" n 1891 I received a skull and a very large living specimen from Mr. . Kohn, of New Orleans, La., of the same species.

The coloration of the skull and neck distinguishes this species at nce from all the others. The whole space between and behind the rbits is characterized by a continuous yellow figure, which sends ackward on each side behind each orbit a strong process of the same olor.

The head resembles that of *Graptemys kohnii*, but is more slender. he symphysis of the lower jaw is longer and the nose projecting. In ll the skulls examined the jugal is excluded from the orbit, a character not seen in the other species of *Graptemys* or *Malaclemmys*. The form of the carapace is very close to *Graptemys kohnii;* the dermal shields are very thin. It is the largest form of *Graptemys*, the shell reaching a length of over 170 mm. in straight line. The color of the shell is light olive with yellow marks on the marginals, the plastron is yellow, with some darker marks. Types: No. 8808. Smithsonian Institution, Washington, D. C. Two not full-grown specimens, collected by Dr. T. H. Bean at Montgomery, Ala.

The genus *Malaclemys*, with the single species *M. centrata* (Bosc. MSS.) Latreille, 1801, is distinguished from *Graptemys* by the lower jaw, which is pointed and not rounded in front, and also by the condition of the quadratojugal and maxillary. In *Malaclemys* the quadratojugal is extensively united with the maxillary; in *Graptemys* these elements are separated by the quadratojugal. The peculiar character of the jugal in *Graptemys pulchra* may perhaps justify the creation of a new genus for this species. I have given to the common " Diamond-back " the name *Malaclemmys centrata* (Bosc. MSS.) Latreille, 1801. The name *M. terrapin* Schoepff, 1793, cannot be used. The same name (*Testudo terrapen*) was given by Bonnaterre in 1789 to the *Trachemys rugosa* Shaw, 1802, of Jamaica. Already in the year 1788, however, Gmelin introduced the name *Testudo palustris* for the Jamaica tortoise; I therefore use the name *Trachemys palustris* Gmelin for the Jamaica tortoise, and that of *Malaclemmys centrata* (Bosc. MSS.) Latreille for the " Diamond-back."

KINOSTERNON LOUISIANÆ spec. nov.

Shell much like *K. pensilvanicum*, but more elongated. Skull different; the lateral hook in the middle of the maxillary very much developed and very sharp; median hook on symphysis not so strong; postorbital arch stronger than in *K. pensilvanicum*. Lower jaw very strong, ending in a sharp point; symphysis of lower jaw larger than vertical diameter of orbit. A yellow-orange stripe from snout over upper part of orbit along neck, one from the angle of the mouth. Four barbels, two just behind the symphysis near together and two farther behind more separated. Limbs and neck olive gray; a few yellow spots on top of the posterior part of head; webs more developed than in *K. pensilvanicum*. Lower jaw with greyish-yellow dots and lines. The whole coloration is very much like that in *Aromochelys tristycha* Ag., which is found together with *K. louisianæ*. seen from above these two animals resemble each other very much. They belong to different genera, but have about the same specific characters.

I have received many specimens of this species through the kindness of Mr. Gustave Kohn, of New Orleans, La. This species is the representative of *K. pensilvanicum* in Louisiana. I have never received a specimen of *K. pensilvanicum* from this locality, and believe that all the specimens which have been described as *K. pensilvanicum* from this State belong to *K. louisianæ.* Type specimen, No. 15527, Smithsonian Institution, from New Orleans, La.

—G. BAUR, *University of Chicago.*

Further Notes on American Box-Tortoises.—In Science, of April 3, 1891 (Vol. XVII, No. 426), I have given the osteological characters of three of the American Box-Tortoises: *Terrapene major* Ag., *T. carolina* L., and *T. ornata* Ag.

Through the kindness of Mr. Gustave Kohn, of New Orleans, La., I have received lately three living specimens of *T. triunguis* Ag. (*C. cinosternoides* Gray, Boul.) Besides I have received a specimen of *T. mexicana* Gray, for which I have to thank Dr. A. L. Herrera, Director of the National Museum, Mexico. Both these forms proved to be very interesting. I give now osteological characters of all the forms of Terrapene.

TERRAPENE MAJOR AG., 1857.

Quadratojugal well-developed, forming a complete zygomatic arch; cervicals long; upper branch of scapula considerably longer than inner branch (endo-scapula); digits with well-developed webs.

Number of phalanges in fore-foot, 2 3 3 3 2; in hind foot, 2 3 3 3 2.

Southern States. Locality of type, Mobile, Ala.

TERRAPENE CAROLINA L., 1766.

Quadratojugal rudimentary, only connected with quadrate; cervicals shorter than in *T. major* Ag.; upper branch of scapula somewhat longer than inner branch (endo-scapula), but not so long as in *T. major*; digits slightly webbed.

Number of phalanges in fore-foot, 2 3 3 3 2 or 2 3 3 2 2; in hind foot 2 3 3 3 2.

Eastern States to Indiana.

TERRAPENE MEXICANA GRAY, 1849 (*Onychotria*).

Quadratojugal rudimentary, only connected with quadrate; cervicals probably as in *T. major;* upper branch of scapula as in *T. major.* No web between the digits and only three claws in the hind foot.

Number of phalanges in fore-foot, 2 3 3 2 2; in hind foot, 2 3 3 3 1.

Mexico.

This species is readily distinct from *T. triunguis* by its oval tectiform carapace. *The additional vertebral shield between the fourth and fifth, seen in both the British Museum specimens, is present also in the specimen received from Dr. Herrera.*

TERRAPENE TRIUNGUIS AG., 1857.

Syn. *Emys kinosternoides* Gray.

Quadratojugal rudimentary, only connected with quadrate; cervicals somewhat shorter than in *T. major*; scapula as in *T. major*; no web between the digits, and only three claws in the hind foot. Shell as in *T. carolina* L.

Number of phalanges in fore-foot, 2 3 3 2 2 or 2 3 3 2 1; in hind foot, 2 3 3 2 1.

Louisiana, Arkansas, Indian Territory, Mississippi, Georgia.

TERRAPENE ORNATA AG., 1857.

Quadratojugal absent; cervicals very short; upper branch of scapula of the same length as inner branch (endo-scapula); digits without distinct web.

Number of phalanges of fore-limb, 2 2 2 2 2; of hind limb, 2 3 3 3 1.

Central States. Type from Upper Missouri, Iowa.

—G. BAUR, *University of Chicago.*

ENTOMOLOGY.[1]

Spiders collected in New Mexico and Arizona.—Among some spiders sent to Professor G. W. Peckham, of Milwaukee, a year or two ago, the following species of Attidæ was found.

Habrocestum hirsutum Peckham. This species was originally described from Oregon. The specimens sent were collected at Las Cruces, New Mexico.

Professor Peckham wrote that there were several other species of Attidæ in the sending, but that they were immature and could not be determined.

Some spiders sent to Dr. Geo. Marx, about the same time, were identified by him as follows. They were all collected at Las Cruces.

Pholcus n. sp. A very interesting one.
Lathrodectus n. sp.
Filistata capitata Hentz.
Ocyale n. sp.
Misumena rosea Keys.
Scytodes thoracica Latr.
Hamataliva grisea Keys.
Loxosceles unicolor Keys.
Dictyna sedentaria Keys.

Dr. Marx wrote that the last five species were of much interest, and mostly very rare.

Recently a lot of spiders was sent to Mr. Nathan Banks, including all that had been collected since the above sendings, both in New Mexico and Arizona. He has reported on them as follows.

The following are from north-eastern Arizona:

Tetragnatha laboriosa Hentz. ♂ and ♀.
Steatoda corollata Linn. ♀.
Misumena vatia Clerck. ♀ and young.
Olios giganteus Keys. Young.
Pardosa n. sp. ♀.
Phidippus sp.? Young ♀. Mr. Banks writes that "this is probably *arizonensis* Peck., but the ♀ has not been described."
Dendryphantes retarius Hentz. ♀.
Dendryphantes octavus Hentz. ♂ and ♀.

---

[1] Edited by Dr. C. M. Weed, New Hampshire College, Hanover, N. H.

Dendryphantes sp. prob. new. ♀. Mr. Banks writes that "this is near *octavus* Hentz, and may be only a variety, but cannot decide without the ♂."

Eris barbipes Peck. Mr. Banks writes that this species "has not been recorded from the United States. It was described from Mexico."

The following are from southern New Mexico, mostly near Las Cruces:

Thanatus coloradensis Keys. ♂ and ♀.
Lathrodectus mactans Koch. Young.
Steatoda corollata Linn. ♂ and Young.
Pholcus n. sp. ♂ and young.
Filistata capitata Hentz. ♂.
Epeira trivittata Keys. ♂ and ♀.
Trochosa sp.? Young.
Marptusa californica Peck. Young.
Astia sp.? Young.
Eurypelma steindachneri Auss. ♂.
Ariope riparia Hentz. ♀.

Lycosa n. sp. ♂. This specimen was collected in the Organ Mountains. It is in all probability the same as the common form here, which is called the "tarantula."

A solpugid, found in southern New Mexico, was also included in the sending to Mr. Banks, and was determined by him as *Datames pallipes* Say.

Mr. Banks, in conclusion, writes as follows concerning this fauna: "Your fauna seems to have a Colorado tinge, with forms from California and the Gulf States. A number of the species run across from Texas to southern California."

The above list makes a showing of twenty-five species of Araneina from the south-western region, which, though small, is a material contribution to the knowledge of this fauna.—C. H. TYLER TOWNSEND.

Lepidopterous gall on Bigelovia.—On June 21, 1892, elongate flower-bud like galls were found on *Bigelovia graveolens*, near Galls Spring, New Mexico. Several which were opened on that date showed within what appear to be lepidopterous larvæ. The latter were reddish in color, somewhat the color of codling moth larvæ. More galls were found, June 22, west of Apache Spring, New Mexico. One of these which was opened showed two very small larvæ within.

Gall. Length 19 mm.; greatest width, 5 mm. Resembling an elongate flower-bud in shape and appearance, elongate pyriform with a stem-like portion about as long as the body of the gall, the whole appearing to be formed of a widened leaf or large stipule of the plant with the edges meeting and grown together, forming an elongate cavity inside, the basal stem portion narrow and more or less cylindrical, gradually thickening at body which is swollen. Stem clothed with fine white wooly fibers on the outside, the body light greenish and not so thickly wooly. Several narrowed and elongate leaves of the plant are grown to the outside of the body, springing from the stem and running longitudinally to tip of gall. These apparently reveal the mode of formation of the gall, which is, if I am not mistaken, formed of a number of the elongate leaves of the plant grown together, the edge of one to the edge of the next. The stem portion is not hollow but solid. The larvæ live in the hollow body of the gall.

Described from one specimen. The larva which was found within this gall shows no traces of thoracic or other legs, but possesses a large and distinct head with strong jaws. I infer that it is lepidopterous.—C. H. TYLER TOWNSEND.

North American Locusts.—Mr. Lawrence Bruner publishes[2] a valuable paper on "The More Destructive Locusts of America North of Mexico." A considerable number of species are treated of, full descriptions being given together with notes on preventive measures. Many new illustrations appear, four of which are reproduced on the accompanying plate, where *a* represents *Acridium frontalis* from Kansas; *b. Dendrottettix longipennis,* the "Post-oak Locust" of Texas *c. Melanoplus robustus* also of Texas; and *d,* the large green Bush-locust (*Acridium shoshone*) which occurs in many of the Southwestern States.

Entomological Notes.—The sixteenth of the admirable series of Reports of Observations of Injurious Insects by Miss Eleanor A. Ormerod of England has recently appeared. Its most distinctive feature in the way of illustrations consists of a number of plates, from photographs, of injuries to turnips and cabbages caused by eel-worms and slime fungi.

Mr. H. F. Wickham is spending the summer collecting insects and other specimens in the region of the West Indies. He is with a party from the Iowa State University.

Dr. A. S. Packard has recently published two important papers on Heterocera. One deals with "The life-histories of certain moths of the family Cochliopodidæ, with notes on their spines and tubercles"[3] and the other records the author's "Studies on the transformations of Moths of the family Saturniidæ[4]". In both papers the armature of the caterpillars is carefully described, and many figures are given.

---

[2] U. S. Dept. Ag., Div. Ent. Bull., No. 28.

Professor C. H. T. Townsend formerly of the New Mexico Agricultural College announces that after June 1, 1893 his address will be: C. H. Tyler Townsend, Curator of Museum, Institute of Jamaica, Kingston, West Indies.

Mr. James Fletcher has favored us with a copy of his "Evidence before the standing Committee of the House of Commons on Agriculture and Colonization" for the session of 1892. It is a careful discussion of the economic value of entomological study.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—May 17.—The following paper was read: Dr. Clarence J. Blake—Out of Darkness into Light; or The Education of a Blind Deaf-Mute.

—SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—May 20.—The following communications were read: Dr. V. A. Moore—The Distribution of Pathogenic Bacteria in the Upper Air Passages of Domesticated Animals; Professor C. V. Riley—Some Further Notes on Yucca Pollination; Professor B. W. Evermann—The Ichthyologic Features of the Black Hills; Dr. W. H. Dall—New Forms of Fossils from the Old Miocene of the Gulf States; Dr. C. Hart Merriam—Biology in our Colleges; Dr. C. Hart Merriam—Facts of General Biological Interest Resulting from a Study of the Kangaroo Rats.

FREDERICK V. COVILLE, *Secretary.*

Anthropological Society of Washington.—May 9.—The following papers were read: Common Errors in Regard to Indian Language, Mr. J. N. B. Hewitt; Primitive Belief in a Future State: a Comparative Study, Mr. H. E. Warner; The Pivot Point in Modern History: Andrew Palaeologus at Barcelona, Col. F. A. Seely; Fourth Centenary of the Discovery of America, at Madrid, 1892, Dr. Thomas Wilson.—WESTON FLINT, *Secretary.*

[3] Proc. Amer. Philos. Soc. v. XXXI, pp. 83–108.

[4] Proc. Am. Acad. Arts and Sciences, 1893, pp. 55–92.

The Agassiz Scientific Society of Oregon met Wednesday, May 10, at 8 P. M., in the Botanical Laboratory of the Agricultural College. The principal paper of the evening was by Professor Dumont Lotz on "Food Adulterants."—F. L. WASHBURN, *Sec.*

SCIENTIFIC NEWS.

—THE entire Leidy collection of Parasites, property of the Biological Department, University of Pennsylvania, has been placed in the hands of Dr. C. W. Stiles for revision. Dr. Stiles intends to publish a descriptive catalogue of this collection, together with a descriptive catalogue of eight other collections now in his possession.

—THE Smithsonian Institution has taken an American table at the Naples Station for three years. Dr. Stiles will publish the correspondence between Secretary Langley and himself relating to the table, in the form of a report to the signers of the memorial presented to the Institution, in a later number of the NATURALIST.

THE next meeting of the Australian Association for the Advancement of Science will be held in Adelaide, South Australia, commencing on September 25, 1893.

The Association has now been in existence since 1888. Four meetings have been held, viz:—

In September, 1888, at Sydney—President, H. C. Russell, C. M. G., B. A., F. R. S., Government Astronomer, N. S. W.

In January, 1890, at Melbourne—President, Baron F. von Mueller, K. C. M. G., Ph.D., F. R. S.

In January, 1891, at Christchurch—President, Sir James Hector, K. C. M. G., M. D., M. D., F. R. S.

In January, 1892, Hobart—President, His Excellency, Sir Robert Hamilton, K. C. B.

The meeting in Adelaide will be presided over by Ralph Tate, F. L. S., F. G. S., Professor of Natural Science at the University of Adelaide.

Since its commencement the Association has grown steadily, and now numbers about 900 members. The work is divided into sections as in the British Association, whose rules on most points have been closely followed.

The meeting of next year will last about a week, during which time the Sections will meet daily for the reading and discussion of papers. During the week there will be various short excursions to places of interest, and some evening entertainments. After the meeting one or two longer excursions will be arranged.

At the time fixed for the meeting, South Australia will be at its best. There is no better time at which to visit Australia than when spring is merging into summer. To naturalists, this time of year is specially attractive, and these may be reminded that at the meeting of the Association they will come into contact with men of like tastes from all parts of Australia.

Should visitors wish to prolong their trip, they will do well to visit during the months of October and November the principal objects of interest in the mainland, and in December, January and February to pass on to New Zealand and Tasmania.

Table of Contents of the North American Review for June, 1893.—THE LESSON OF THE NAVAL REVIEW, by the Hon. Hilary A. Herbert, Secretary of the Navy; Who are the Greatest Wealth-Producers? W. H. Mallock; How to Check Testamentary Litigation, Surrogate Ransom, of New York; Disappearing Dickensland, Charles Dickens; A Look Ahead, by Andrew Carnegie; Police Protection at the World's Fair: I. By the General Superintendent of the Chicago Police—II. By the Chief of the Secret Service, World's Columbian Exposition; Thirty Knots an Hour to Europe, Professor J. H. Biles, Designer of the "Paris" and the "New York:" Reform of the Drink Traffic, the Rev. W. S. Rainsford, D. D.; The Financial Outlook, by the Hon. W. Bourke Cockran. *Notes and Comments.*—Christ as an Orator, T. Alexander Hyde. A Farmer's View of Free Coinage, Newton F. Bunnell; The Art of Living Two Hundred Years, William Kinnear; Inebriety from a Medical Standpoint, Dr. E. F. Arnold.

THE
AMERICAN NATURALIST

VOL. XXVII. August, 1893. 320

THE SPORE-FORMING SPECIES OF THE GENUS SACCHAROMYCES.

J. CHRISTIAN BAY.

In his monograph on the *Saccharomycetaceae* [*Saccardo*: Sylloge Fungorum omnium hucusque cognitorum, Vol. VIII, page 916–22.] *J. B. de Toni* enumerated 31 species of the genus *Saccharomyces* Meyen upon which the family is based by *Reess* in the year 1870, when it was separated from the *Ascomycetes*. Since *DeToni's* monograph was published, our knowledge of this important family, among which very important culture plants are found, has been widely broadened, mainly by the investigations of *Emil Chr. Hansen*, so that several species may be added to those already known. But further *De Toni*, in his monograph, has given no notice to the species described and figured by *Hansen*, nor to the extensive literature based upon these. We find in the "Sylloge" species as *Saccharomyces ellipsoideus* Reess, *S. conglomeratus* Reess, *S. Pasteurianus* Reess, and the description of the species is based solely upon the morphology of the cells. In fact, for the description not only reliable morphological but purely physiological characters of these fungi have been used and must to a certain extent be used. *Reess* and other mycologists before *Hansen* and his school have taken in consideration for the description almost solely the morphological characters of the cells; but we may easily observe that the form and size, etc., of the cells have very little to do with the species question. The latter depends much more upon the number of spores found in the cells, the conditions for the spore-formation, and the effect upon the various kinds of sugar. As therefore *De Toni's* monograph can not pretend to give a correct account of the species known up to date, I have tried to bring together the forms in which a formation of spores has been found, with description of the various stages in their development. A later number of this series, materials for a monograph on the alcoholic fermentation, will contain the literature in full.

Fungaceae. Linné, Gen. 1737, page 327.

SACCHAROMYCETACEAE. Reess.

M. Reess: Botanische Untersuchungen ueber die Alkoholgaehrungspilze, 1870. Winter: Die Pilze (in Rabenhorst's Kryptogamenflora)I, 1, page 68. *Blastomycetes* Frank: Leunis Synopsis, Botanik, III, page 595.

Genus: *Saccharomyces.* Meyen.

Meyen: Wiegmann's Archiv. Vol. IV. 2, page 100, 1838. Reess, l. c. Winter, l. c., page 69. Joergensen, Die Mikroorganismen der Gaehrungsindustrie, 1890, page 123. Saccardo, Sylloge, VIII, page 916 [De Toni.]. Ludwig: Lehrbuch der niederen Kryptogamen, 1892, page 210.

All species unicellular, often adhering together, forming a false mycelium. Hyphae or regular mycelia never occur. Cells circular, oval, or ellipsoid, often rectangular. *Habitat:* Causing the conversion of glycose into alcohol and carbonic acid, and a few other products, most of the species are always found in fermenting fluids. Some species are found in other places, most of these, however, have not been observed forming spores. Further investigation must determine the true nature of the latter; probably some of them belong to the Torula-forms in the sense of Pasteur. Owing to the general feeling that the Saccharomyces are characterized mainly by their faculty of spore-formation, I took up only these forms in the present synopsis.

Propagation by buds. This is the general way of propagation. Where a vigorous conversion of sugar is caused by the Saccharomyces, an equal rapidity of the budding is always observed.

Propagation by spores. In all of the species mentioned here a spore-formation has been traced and investigated, and many species are based upon the conditions for this formation, which *Hansen* has found constant in all the forms described and studied by him.—Form of spores round or oval, in one species, "hat-formed;" their number 1–10 or more. Appearance various in the various species, also transparency. Spores invariably endogenous.

Appearance of the colonies. When cultivated in a 10 per cent. beer-wort-gelatine the colonies appear as round or oval, white macroscopic spots, the outline of which is even in some, uneven in other species.—Cultivation for spore-formation, see *Hansen:* Meddelelser fra Carlsberg-Laboratoriet. Vol. II, page 152; *Holm* and *Poulsen,* ibidem page 218. (Compte Rendus, etc., Carlsberg. II, page 97; *Holm and Poulsen,* ibid, page 141.) 1886–88.—For the formation of a top-vegetation see each single species.

1. *Saccharomyces cerevisiae I.* Hansen.

Hansen, l. c. II, page 67; Plate I, fig. 1; Pl. III, fig. 1–3.

Sacch. cerevisiae Meyen (ex parte) Wiegm. Arch. IV, page 109; Reess Unters. page 81; Pl. 1, fig. 1–17; Pl. II, fig. 1–6. Winter: Pilze. I, 2, page 69, and fig. Joergensen Mikroorg. 1890, page 124. Ludwig, l. c. page 215.

Torula cerevisiae Turpin: Mém. de l'Académie XVII, 1840, page 93; Plate I-   , Comptes Rendus de l'Acad. Vol. VII, 1838, page 369 (without plates.), Liebigs Annalen XXIX, page 93. Kuetzing: Journal fuer prakt. Chemie Vol. XI, page 387, 1837, and plate.—Cryptococcus cerevisiae Kuetz.: Phycol. gener. page 148, 1843; Cryptococcus cerevisiae Kuetz, Species Algarum, page 146, 1849.—Hormiscium cerevisiae Bail in Flora 1857, page 417. Pasteur: Ann. d. Phys. et de Chim. LXII, page 332–426. id. Etudes sur la bière, page 185–192, 1876. Garnier: Ferments et Fermentations Paris, 1888, page 75.

This form and many varieties of it is common in breweries. The specific form gives a top-fermentation. Cells 2, 5 μ–6μ; the young culture gives mainly round and slightly oval, or ellipsoid cells. Spore-formation found: Maximum: 36°–37° C., minimum 11°–12°C. The first trace of spores at 25° C. found in 23 hours, at 15° C. in 72 hours. Number of spores generally 1–4, of round shape and of strong reflecting power.

In giving a key to the determination of the species, it seems best to select the occurrence of spore-formation by 25° and 15°, not only because this is most instructive but also because these temperatures are used for examination of the yeast in the breweries, the physiological yeast-analysis; another reason is that it enables the investigator to keep two thermostates at the points 25° and 15° as long as the investigation lasts. The very best apparatus for these investigations is, of course, the Panum thermostate, described by Pedersen in Meddelelser fra Carlsberg-Laboratoriet, Vol. I, page 48–52, 1878, or by Panum in Nordisk medic. Arkiv. Vol. X, No. 4.

This species and its varieties, which are cultivated for constant use in brewing establishments are known as "cultivated yeasts," the other forms, which cause "sickness" in the product, being commonly called "wild yeasts." In these cultivated forms, the spores are very refractive, compared with the other forms, and their spore-forming cells often display a singular formation of a thick wall which divides the cell into various parts, each of these containing a spore. This "wall" is very refractive and consists of the protoplasm of the cell, pressed in between the walls of the spores. But the same formation may also appear as a result of the spores being pressed against each other. Occasionally there is a real formation of a wall, when the spores cannot be separated, and then the cell turns out to be a kind of a sporangium.

A superficial layer of cells which we will call top-vegetation occurs at 3°–5° C. never after 7–10 days at 20–22° C. This kind of vegetation generally gives cells of a singular shape.

Among the many varieties found in breweries all over the world all cannot be sure to give the same results; but the question of variation has still to be debated.

2. *Saccharomyces Pastorianus I.* Hansen.

Hansen, l. c. II, page 68; Plate I, fig. 2; Pl. V, fig. 1–3.—S. Pastorianus Reess, l. c. page 83; Pl. II, fig. 11–13 (ex parte.). Winter, l. c. page 70. Saccardo, l. c. page 917. Pasteur: Etudes sur la bière, 1876, page 150, fig. 128, Pl. X–XI, page 171–75, fig. 33–37, Pl. XII (ex parte.). Garnier, l. c. page 78. Joergensen, l. c. page 127. Ludwig, l. c. page 215.

Often found in the cellars where the fermentation of the beer takes place; it gives a bottom- fermentation. A young culture in beer-wort gives round and oval, sausage-formed cells; the spores are formed at 27°, 5 in 24 hours, at 15° in 50 hours, maximum being at 29°, 5–30°, 5, minimum at 3°–4°. Number of spores 1–5, commonly 5–10 are also found, their diameter being 1.5–5μ.

Top-vegetation does not occur at 34°, but in 8–15 days at 20°–22°; it gives cells of irregular shape, long, sausage-formed, as well as small, round and oval cells. Gives the beer a very bitter taste.

3. *Saccharomyces Pastorianus II.* Hansen.

Hansen, l. c. page 69; Pl. I, fig. 3; Pl. V, fig. 1–3. Other references under the preceding species (ex parte.). Joergensen, l. c. page 129. Ludwig, l. c. page 215.

Common in the air in the brewery, consequently often found in the fermenting beer. Cells round or long oval. Spore-formation: 25° in 25 h., 15° in 48 h. Maximum 27°–28°, minimum 3°–4°. Spores like those of the preceding, wall-formation sometimes found.

Gives a weak top-fermentation. Top-vegetation gives, when the culture is young, a large number of small, round or oval cells, when old, we find long, irregular shaped forms; not found at 34°, at 20°–22° in 8–15 days.—Gelatine-cultures give round, even-edged colonies.

4. *Saccharomyces Pastorianus III.* Hansen.

Hansen l. c. II, page 70, Pl. II, fig. 1; Pl. VI, fig. 1–3. See preceding. Joergeusen, l. c. page 130. Ludwig, l. c. page 216.

Found causing a peculiar disease in the yeast. Gives a well marked bottom-fermentation. Cells long, oval and ellipsoid. Spore-formation: 25° in 28 h., 15° in 35 h. Max. 27°–28°; Min. 4°. Top-vegetation never found at 34°, occurs in 9–12 days at 20°–22°, the culture giving, when old, very irregular, almost thread-shape cells.—Gelatine-culture has round colonies with fringed edges.

5. *Saccharomyces ellipsoideus I.* Hansen.

Hansen, l. c. II, page 71; Pl. III, fig. 2; Pl. VII, fig. 1–3.

S. ellipsoideus Reess, l. c. page 82; Pl. III, fig 1–7. Pasteur, l. c. page 242, fig. 58. Joergensen, l. c. page 132. Ludwig, l. c. page 216. [" Wine-yeast."]

Found on the surface of grapes. Cells round, oval, ellipsoid; gives bottom-fermentation. Spore formation: 25° in 21 hours. 15° in 45 h.; maxim. 30°, 5–31°, 5; minim. 7°, 5. Top-vegetation gives always round and oval, scarcely long and irregular cells, does not occur at 38°, but at 20°–22° in 10–17 days.

5. *Saccharomyces ellipsoideus II.* Hansen.

Hansen, l. c. II, page 71; Pl. II, fig. 3; Plate VIII, fig. 1–3. Reess, Pasteur loci cit. Joergensen, l. c. page 135. Ludwig, l. c. page 216.

Found together with S. Pastorianus III in diseased yeast. Gives sometimes top-, sometimes bottom-fermentation. Cells similar to those of S. ellipsoideus I. Spore-formation: 25° in 27 h., 15° in 70 h. Max. 33°–34°; min. 8°.—Young top vegetation gives round and oval cells, occurs never at 40°, at 20°–22° in 4–6 days; the old vegetation has long cells, and a mycelium-like appearance.

7. *Saccharomyces Marxianus.* Hansen.

Hansen: Annales de Micrographie, 1888, Nr. 2–3, page 3, l. c. page 222, Joergensen, l. c. page 136. Ludwig, l. c. page 219.

Found on grapes. In beer-wort it gives a number of elliptic, egg-formed cells, and later small colonies of mycelium-like growth. Spores not easily formed, the latter being generally round or slightly oval, but often kidney-shaped. Top-vegetation scarce. On gelatine a "false" mycelium is often formed.

8. *Saccharomyces exiguus.* Hansen.

Hansen: Annal. d. Microgr. 1888, Nr. 2–3, page 5; l. c. II, page 225. [Reess, l. c. page 82; Pl. II, fig. 7–8, and Hansen, l. c. I, page 227. (ex parte.)]. Saccardo, Sylloge, VIII, page 917, 1889. Joergensen, l. c. page 136. Ludwig, l. c. page 220. Winter, Pilze, I, page 70 (ex parte.).

Probably a distinct species. In beer-wort good development and often formation of a "yeast-ring." Cells 2–5μ, round and oval, scarcely long.—Found in press-yeast. Spores rare, top-vegetation seldom occurs. No mycelial growth in fluids.

9. *Saccharomyces membranaefaciens.* Hansen.

Hansen: Ann. d. Micr., l. c. page 6; l. c. II, page 225. Saccardo, l. c. page 918. Joergensen, l. c. page 137. Ludwig, l. c. page 220.

Found on decaying elm-roots. Gives in beer-wort abundant top-vegetation of oval cells. Spores easily formed both in cultures in fluid and in spore-cultures. Gelatine-cultures show reddish colonies, the substratum being slowly liquefied.

10. *Saccharomyces Ludwigii.* Hansen.

Hansen, Centralbl. f. Bakteriol. u. Paras. V, page 638, 1889; Meddel. III, page 62, 1891. Joergensen, l. c. page 138. Ludwig, l. c. page 218.

Found in "Schleimflüsse" of oak-trees. Cells elliptical, flask-formed, or long and irregular shaped. On gelatine a mycelium is developed, with branches and septa. Cultures in fluids give spores abundantly. Power of variation great, some forms easily giving spores, while others do not. Germination of spores peculiar; see Hansen, Medd. III, page 62–70. 1891.

11. *Saccharomyces anomalus.* Hansen.

Hansen, l. c. III, page 71. Ludwig, l. c. page 219.

In impure yeast from brewery and on grapes. Cells round and oval, rarely long. Spores formed both in the bottom-yeast and in the top-vegetation, they are "hat-shaped," a form not occurring in any other species.

12. Saccharomyces Hansenii. Zopf.

Zopf: Berichte der Deutschen bot. Gesellschaft, Vol. VI, page 94–97; 1889, with figures.

Found in cotton-dust. Spores 1–2 in each cell, ball-formed, diam. 2–4μ. This species does not give rise to alcoholic fermentation, but it brings fermentation in a solution of saccharose, dextrose, lactose, galactose, maltose, mannit, dulcit, and glycerin, converting these sugars and the glycerin into oxalic acid, the latter being found at the bottom of the solution as calcium oxalate when the fermentation is at an end.

13. Saccharomyces Joergensenii. Lasché.

Lasché: Der Braumeister, Vol. V, page 242–245. Chicago, 1892; and Zeitschrift f. d. gesammte Baruwesen, Munich 1892. With figures.

Found in "temperance-beer." Cells 2.5–5.5μ. Spore-formation: 26° in 20 h., 25° in 17 h., 12° in 4 days. Maxim. 28°–30°, Min. 8°: "wall "-fermation in the spore-forming cells scarce. Causes no disease in the beer. Gelatine-cultures give a "false mycelium."

[*14. Saccharomyces conglomeratus.* Reess.

Reess, l. c. page 82; Pl. II, fig. 14–16. Winter, l. c. page 70. Saccardo, l. c. VIII, page 917. Joergensen, l. c. page 140.

Cells 5–6μ. Typical forms appear with more than one bud on the propagating cell. It is hardly a distinct species, because such forms often are found in old cultures by Hansen, Will, and other investigators,[1] mainly in top-vegetation.]

15. Saccharomyces albicans. Reess.

Reess; Sitzungsberichte d. phys. med. Gesellschaft Erlangen. 1877. Winter, l. c. page 72.

---

[1] For example, see Will's figures.

Oidium albicans Robin (Histoire naturelle d. vég. parasit. page 488; pl. I, fig. 3–7.)

Cells round and oval, found in the mouth of small children. Number of spores one. Has been considered the same as Sacch. mycoderma (Mycod. cerevisiae) which forms no spores and therefore is probably no Saccharomyces.

16. Saccharomyces Reessi. David.

David: Annalen der Oenologie IV, page 223, 1878.

Found in wine-fermentation. Cells form three spores. Almost unknown.

17. Saccharomyces galacticola. Pirot. and Rib.

Pirotta and Riboni: Studii sul latte, page 14, pl. VI, fig. 6; pl. XVII, fig. 1, 1879.

Occurs in "fermenting" milk where it forms smaller rows, sometimes a short mycelium. Cells with 2–4 spores.

18. Saccharomyces I of Will.

Will: Zeitschrift f. d. gesammte Brauwesen. No. 7–8. 1891.

In beer; the taste of the product becomes very much affected. Cells oval or of a pastorian form. The top-vegetation has long cells and a "false mycelium," when old. The old bottom-yeast forms short rows, similar to those cultivated varieties which give top-fermentation. Spore-formation: 25° in 14, 5 h.; 15° in 41 h. Max. 41°; min. 4°–5°. Top-vegetation: 41° never; 22°–23° in 4–6 days. "Conglomeratus"-forms (see No. 14) figured.

19. Saccharomyces II of Will.

Will l. c.

Habitat as the preceding form. Spores: 24°,5–25° in 31 h.; 15°–15° 5 in 74 h.; diam. 2–4μ, number: 1–4. Max. 32°; min. 0°, 5–1°. Top-vegetation found, often developing into the formation of a yeast-ring.

20. Saccharomyces minor. Engel.

Engel: Les ferments alcooliques, 1872. Arcangeli: Nuovo giorn. bot. Ital, 1888, page 303. Joergensen, l. c. page 139.

Sphaerous cells, diam. 6μ. Short rows. Spore-forming cells 7–8μ; spores 2–4, diam. 3μ.

21. Saccharomyces Ilicis. Groenlund.

Groenlund: Zeitschr. f. d. gesammte Brauwesen, 1892, page 289, with fig., and Videnskabelige Meddelelser f. d. naturhist. Foren. i Kjoebenhavn, Vol. LIV, page 5, 1893.

Found on fruits of Ilex aquifolium. Cells round, similar to Sacch. cerev. I. Spore-formation: 25° in 22 h., 15°. 5 in 3 days. Max. 36°–37°; min. 9°. 5.—Bottom-fermentation. Top-vegetation found after 122 or 165 days in the temperature of the room, in sunlight after 93 days. Gives the beer a disagreeable, bitter taste.

22. Saccharomyces Aquifolii. Groenlund.

Groenlund, l. c., page 297; Vid. Medd., page 9.

On Ilex-fruits. Cells larger than those of the preceding. Spores: 25°, 5–26°, 5 in 29 h.; 16° in 3½ days. Max. 27° 5–28°, 5; min. 10°–10°, 5. Gives the beer a sweet-bitter taste. Top-fermentation.

CONCLUDING REMARKS.

If we were able to trace the *Saccharomycetaceae* back into their history, we should be able to form an opinion with regard to their origin. But, for the present time, there is no reason whatever for regarding these organisms as a form of some fungi of higher organization which have been subject to a one-sided evolution. We have never seen a *Saccharomyces* develop into anything but a *Saccharomyces*.

The term "fermentation" is hardly to be used any more. Originally, in the sense of *Liebig*, it meant the conversion of carbo-hydrates into products of a lower combination, terminating in the formation of CO_2 and H_2O, by means of the life-activity of lower organisms (the theory of vitality). Now, however, it is also applied to the *conversion of proteid substances* by means of a life-activity. Since the enzymes have been found and studied, it would be more proper to speak of the conversion of such and such matter into certain products

I. THE CONDITION OF THE SPORE-FORMATION AND OF TOP-VEGETATION.

Temp. °C.	S. cerevisiae I.		S. Pastor I.		S. Pastor II.		S. Pastor III.		S. ellips. I.		S. ellip, II.	
	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.
40.°												0.
38.										0.		—
37	0; 29 h.											
35											0.	
34		—; max.		0.		0.		0.		—	—; 31 h.	
32									0.			
31				0.					—; 36 h.			
30	Opt. 20h.			—; 30 h.					—23 h.			
29			—; 27 h.		0.		0.				Opt.; 22 h.	
28				—	—; 34 h.	—	—; 35 h.	—				
27			Opt.; 24 h.									
25	—; 23 h.		—; 24-26 h.		Opt.: 25 h.		Opt.; 28 h.		—; 21 h.	—; 10-17 d.	—; 27 h.	—; 4-6 d.
20-22		7-10 d.		—; 8-15 d.		—; 8-15 d.		—; 9-12 d.		—; 15-30 d.		—; 8-10 d.
13-15		15-30 d.		—; 15-30 d.		—; 10-25 d.		—; 10-20 d.				
11	—; 10 d.	—; 10 d.										
9	0.											
8							—; 9 d.				—; 9 d.	
7										—		
5		0.		—		—		—		0.		—
4			— } 14 d.		— } 17 d.		0.		0.		0.	
3			—		—							
2				0.		0.		0.				0.
0.5.					0.							

0 signifies no growth.
— signifies that the process takes place.

h. hours.
d. days.

II. ACTION OF THE SPORE-FORMING SACCHAROMYCES ON DIFFERENT KINDS OF SUGAR.

	$C_6H_{12}O_6$	Invert sugar formed and the invertin fermented.	$C_{12}H_{22}O_{11}$.	Maltose.	Lactose.
S. cerevisiae I. S. Pastorianus I-III. S. ellipsoideus I-II. S. Ilicis; S. aquifolii.	0.	—	—	—	0
S. Marxianus; S. exiguus. S. Joergensenii; S. Ludwigii.	0.	—	—	0.	0.

0 signifies no fermentation; — signifies a fermentation.

III. SIZE AND NUMBER OF SPORES.

No.	Spores.		No.	Spores.	
used above.	Diameter.	Number.	used above.	Diameter.	Number.
1	2,5–6μ.	1– 5.	12		
2	1,5–5μ.	1–10.	13	1-2,5μ.	2–4.
3	2–5μ.	1– 7.	14		
4	2–4μ.	1–10.	15		1.
5	2–4μ.	1– 4.	16		3.
6	2–5μ.	1– 4.	17		2–4.
7	2–4μ.		18	1,5–5μ.	1–5.
8	2–4μ.	2– 3.	19	2–4μ.	1–4.
9			20	3.	2–4.
10		1– 8.	21		
11		2– 4.	22		

through the life-activity of this or that organism, or enzyme, and this mode of expression would also indicate more about the process than the terms fermentation or putrefaction are able to do.

The names yeast or yeast-fungi ought to be used exclusively on the species of Saccharomycetes, not including the mycoderma (cerevisiae and vini—Saccharomyces mycoderma), Torula, and those of the moulds which give either no fermentation or a fermentation (conversion of glucose) with a large per cent. of alcohol. And, finally, the genus Saccharomyces should comprise only the spore-forming species.

MISSOURI BOTANICAL GARDENS, May, 1893.

NOTES ON THE MARINE BIOLOGICAL LABORATORIES OF EUROPE.

By Bashford Dean,
COLUMBIA COLLEGE, NEW YORK.

PART II.

Naples.

The Stazione Zoologica at Naples during the past twenty years has earned its reputation as the center of marine biological work. Its success has been aided by the richness of the fauna of the Gulf, but is due in no small degree to careful and energetic administration. The director of the station, Prof. Dohrn, deserves no little gratitude from every worker in science for his untiring efforts in securing its foundation and systematic management. Partly by his private generosity and partly by the financial support he obtained, the original, or eastern building was constructed. Its annual maintenance was next assured by the aid he secured throughout (mainly) Germany and Austria. By the leasing of work tables to be used by representatives of the universities, a sufficient income was maintained to carry on the work of the station most efficiently. A gift by the German government of a small steam launch added not a little to the collecting facilities.

Attractiveness is one of the striking features of the Naples station. It has nothing of the dusty, uncomfortable, gloomy air of the average university laboratory. Its situation is one of the brightest; it has the gulf directly in front, about it the city gardens, rich in palm trees and holm oaks. The building itself rises out of beds of century plant and cactus, like a white palace; the fashionable drive-way alone separates it from the water's edge. In full view is the Island of Capri, to the eastward is Vesuvius,—a bright and restful picture to one who leaves his work for a five minutes stroll on the long, covered balcony which looks out over the sea.

The student, in fact, knows the Naples station before he visits it, although he can hardly anticipate the busy and profitable stay that there awaits him. He has received the circular from the Secretary of the laboratory while perhaps in Germany, when he secured the privilege of a table. He is told of the best method of reaching Naples, the precautions he must take to secure the safe arrival of his boxes and instruments. He is told to send directions as to the material he desires for study; he is notified of the supplies which will be allowed him, and of the matters of hotels, lodging and banking, necessary even to a biologist. At the first sight of the building he is impressed most favorably, and it is not long before he comes to look upon his work-place as his particular home, open to him day, night and holidays. He likes the general air of quietness,—in no little way significant of system in every branch of the station's organization; his neighbors are

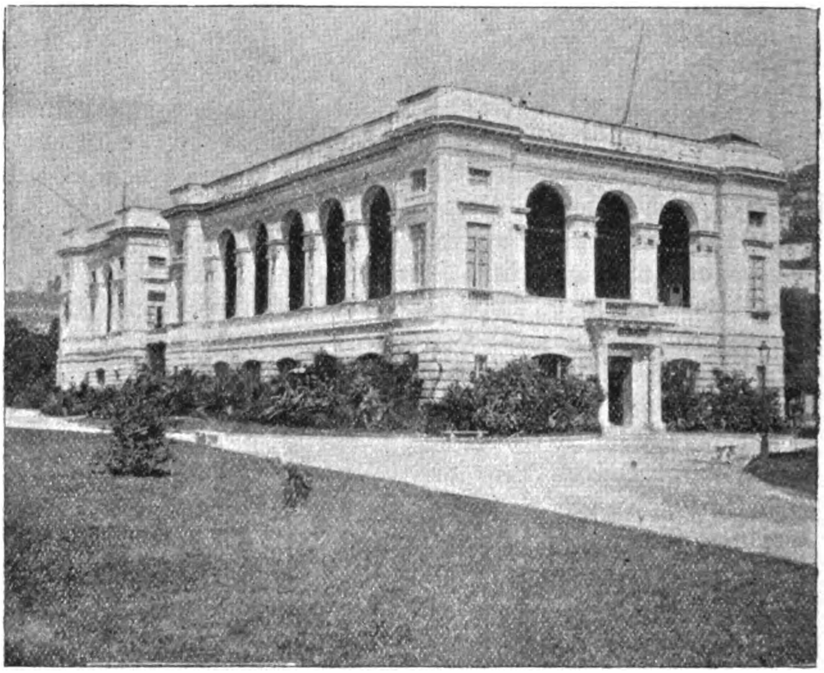


FIG. 1.
Stazione Zoologica of Naples. From view taken by writer, June, 1891.

friendly and he feels that even the attendants are willing, often anxious to give him help.

At present the station at Naples consists of two buildings; the first shown in the foreground in the accompanying figure (Fig. 1), is the older, the main building, behind it is the newly built physiological laboratory. In the basement of the main building is the aquarium, well managed, open to the public, and eagerly visited. Passing into the aquarium room from the main entrance, one descends into a long, dark, concreted room, lighted only through wall-tanks brilliant on every side with the varied forms of life. There are in all about two dozen large aquaria embedded in the walls of the sides and of the main partition of the room. The water is clear and blue. The background in each aquaria, built of rock work, catches the light from above and throws in clear relief the living inmates. The first tank will perhaps be full of star fish and sea urchins, bright in color, often clustered on the glass each with a dim halo of pale, threadlike feet. In the background may be a living clump of crinoids, flowering out like a garden of bright colored lilies. In a neighboring tank, rich with dark colored seaweeds, will be a group of flying gurnards, reddish and brilliantly spotted, feeling cautiously along the bottom with the finger-like rays of their wing-shaped fins. Here too may be squids, delicate and fish-like, swimming timidly up and down; perhaps a series of huge triton snails below amid clustered eggs of cuttle fish. In another tank would be a bank of sea anemones with all the large and brilliant forms common to southern waters. Here may be corals in the background and a forest of sea fans in orange, red and yellow, with a precious fringe of pink coral, flowering out in yellow starlike polyps. There may again be a host of ascidians, delicate, transparent, solitary forms, the lanky Ciona, the brilliantly crimson Cynthia and huge masses of varied, compound forms. Swimming in the water may be chains of Salpa and occasionally a number of Amphioxus, the latter, as they from time to time emerge from the sandy bottom, flurry about as if with sudden fright, quickly to disappear. Variety is one of the striking characters of neighboring tanks. In one, brilliant forms will outvie the colors of their neighbors, in another, the least obtrusive mimicry will be exemplified. The stranger has often to examine carefully before, in the seemingly empty tank, he can determine on every side the living forms whose color characters screen them effectively. Thus he will see sand-colored rays and flounders, the upturned eyes of the curious star-gazer almost buried in the sand, a series of mottled crustaceans wedged in a rocky background, an occasional crab wandering cautiously about, carrying a protective garden of seaweeds on his broad back; odd sea horses posing motionless, mimicing the rough stems of the seaweeds. In the larger tank sea turtles float sluggishly about; and coiled amid broken earthern jars, are the sharp-jawed murrys, suggestive of Roman dinners and of the cultural experiments of Pollio. Aëration in the aquaria is secured effectively by streams of air which are forced in at the water surface and subdivide into bright clouds of minute silvery bubbles. The tanks are cared for from the rear passage-ways; attendants are never seen by visitors and constant attention has given the aquaria a well earned reputation. Descriptive catalogues with figures enable the stranger to better appreciate the aquarium.

To the remainder of the building strangers are not admitted. A marble stairway leads from the door of the aquarium to a loggia which opens into the territory of the students. A long pathway of grating extends across the open center of the building,—whose skylight top admits the light to the aquarium below. On the one hand is the main laboratory room, on the other the library and separate rooms intended for more fortunate investigators. One enters the main laboratory, passes a wall of student aquaria and sees a series of alcoves formed by low partitions, each work place with its occupant, his apparatus, his books, his jars,—altogether often a picture not of the utmost tidiness. A small iron staircase leads to a gallery which gives a second tier of work places and doubles the working capacity of the room. Here, side by side, will be representative workers from universities of every country of Europe.

The library room adds not a little to the attractiveness of the Naples station. It is a long room, and, as shown in

(Fig. 2), is adorned with frescoes in a truly Italian style. It looks out into a long loggia with view of the sea and Capri, where the student is wont to promenade or retire in after lucheon hour with easy chair and book. The working library is of the best and is sure to contain the results of the most recent researches. The desk shown in the figure is one on which each day is to be found the latest publications. In the upper pigeon holes are the cards prepared for each investigator on his advent to Naples; with these he replaces the volumes which he has taken to his work place. Every

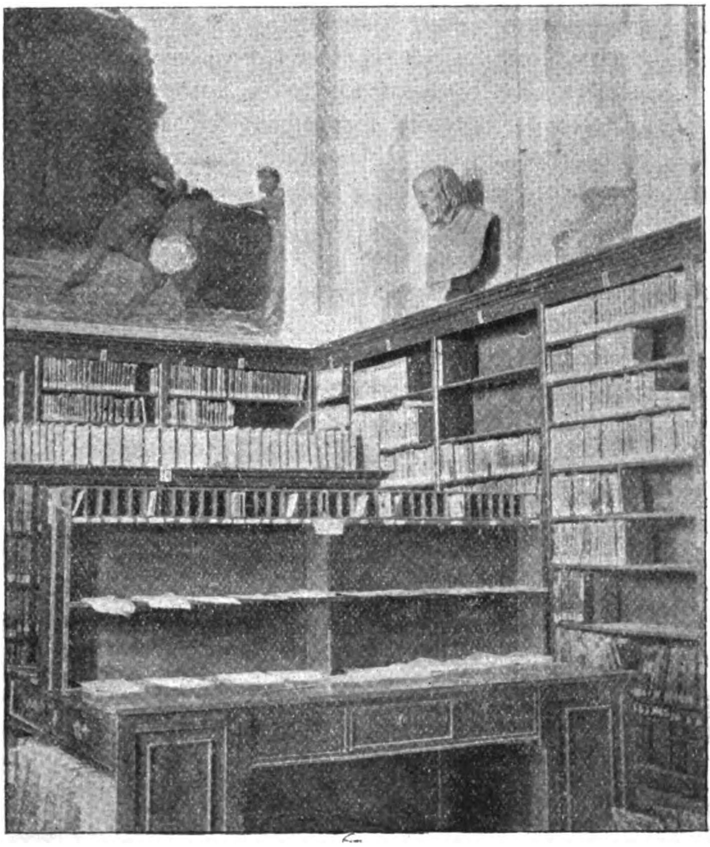


FIG. 2.

Naples. Corner of north end of Library: Photographed by writer, May, 1891.

division of the laboratory is carefully organized and is under the charge of a special assistant. Prof. Hugo Eisig, the assistant director, has taken the welfare of each student under his personal charge, and it is not until the end of his stay that the visitor recognizes how much has been done for him.

There is no more interesting department of the station than that of receiving and distributing the material. Its headquarters is in the basement of the physiological laboratory, and here Cav. Lo Bianco is to be found busy with his aids and attendants amid a confusion of pans, dishes and tables, encountering the Neapolitan fishermen who have learned to bring all of their rarities to the station. The specimens are quickly assorted by the attendants; such as may not be needed for the immediate use of the investigators are retained and prepared for shipment to the universities throughout Europe. The methods of killing and preserving marine forms have been made a most careful study by Lo Bianco and his preparations have gained him a world wide reputation. Delicate jelly fish are to be preserved distended, and the frail forms of almost every group have been successfully fixed. The methods of the Naples station were kept secret only until it was possible to verify and improve them as it was not deemed desirable to have them given out in a scattered way by a number of investigators.

Lo Bianco has made the best use of the rich material passing daily through his department, and has been enabled to prepare the most valuable records as to spawning seasons and as to larval conditions. He knows the exact station of the rarest species, and it seems to the stranger a difficult matter to ask for a form which cannot be directly or indirectly procured. It adds no little to the time saving of the student to find each morning at his work place, the fresh material which he has ordered the day before, and there is usually an embarrassment rather than a dearth of riches.

A collecting trip often occurs as a pleasant change from the indoor work of the investigator. An excursion to Capri may be planned; the launch will be brought to the quay near the station and the party will embark. The collecting tubs are soon scattered over the deck and filled with the dredge contents. Some of the passengers are quickly at work sorting out their material, this one seizing brachiopods, another compound ascidians, another sponges. Others will wait until the surface nets have been brought in and the contents turned into jars. All will depend upon Lo Bianco as an appellate judge in matters of identification..

Many Americans have availed themselves of the privileges of Naples and the former lack of support of an American table needs little comment. Of those who have hitherto visited Naples not less than three-quarters have been indebted to the courtesies of German universities. At present, of the two American tables, one is supported by the Smithsonian Institution, the other by gift of Mr. Agassiz.

The entire Italian coast is so rich in its fauna that it is due perhaps, only to the greatness of Naples, that so few stations have been founded. Messina has its interesting laboratory well known in the work of its director, Prof. Kleinenberg. The Adriatic, especially favorable for collecting, has at Istria a small station on the Dalmatian coast, and at Trieste is the Austrian station.

TRIESTE.

Trieste possesses one of the oldest and most honored of Marine Observatories, although its station is but small in comparison with that of Naples, Plymouth or Roscoff. Its work has in no small way been limited by scanty income; it has offered the investigator fewer advantages and has therefore become outrivalled. During a greater part of the year it is but little more than the supply station of the University of Vienna, providing fresh material for the students of Professor Claus. Its percentage of foreign investigators appears small; its visitors are usually from Vienna and of its university.

Trieste is in itself a small but busy city, growing in active commerce. Its quays are massive and bristle with odd shaped shipping of the Eastern Mediterranean. Its deep and basin like harbor affords a collecting ground as rich as the Gulf of Naples.

The station has been located at a quiet corner of the harbor, just beyond the ledge of the lighthouse. Its building is somewhat châlet-like, situated on a small, well wooded knoll, as seen in the adjacent figure (Fig. 3). About it are trellis covered grounds enclosed by high walls, and separated from the harbor only by the main roadway of the quays. One enters the laboratory garden through a large gateway and passes into a court yard whose outhouses disclose the pails and nets of the marine laboratory. Perhaps an attendant will here be sorting out the captures which a bronze-legged fisherman has just brought in.

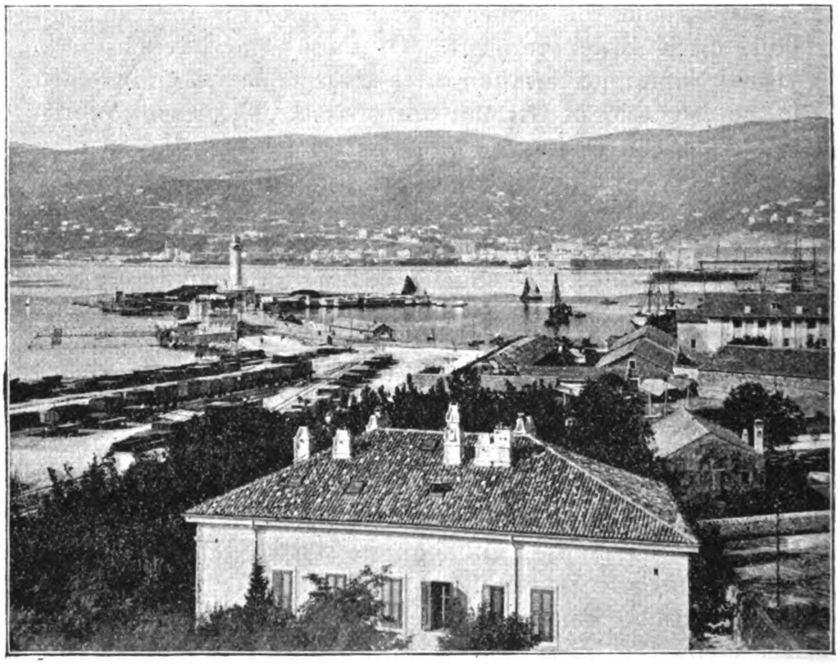


Fig. 3.

Marine Station at Trieste. From photograph received recently from Dr. Graeffe.

A library and the rooms of the director, Dr. Graeffe, are close by the entrance of the building. In the basement is the aquarium room.—somewhat dark and cellar like; its tanks small and shallow, their inmates representing especially stages of Adriatic hydroids and anthozoans. On the second story are the investigators' rooms, large, well lighted, looking out over garden and sea. Near by is a museum of local fauna, rich in crustaceans and in the larval stages of Adriatic fishes.

GERMANY, NORWAY, RUSSIA.

The German universities have contributed to such a degree to the building up of the station at Naples that they have hitherto been little able to avail themselves of the more convenient but less favorable region of German coasts. The collecting resources of the North Sea and of the Baltic have perhaps been not sufficiently rich to warrant the establishment of a central station. On the side of the Baltic, the University of Kiel, directly on the coast, may itself be regarded a marine station. At present the interest in founding local marine laboratories has, however, become stronger. At Plön, at a corner of the North Sea not far from Flensburg, is established a small station under the directorship of Professor Zacharias,—and the first number of its contributions has recently been published. In addition the newly acquired Heligoland has become the seat of a well equipped Governmental station, under the directorship of Dr. R. Heincke. The island has been long known as most favorable in collecting regions, and its position in the midst of the North Sea fisheries gives it especial importance.

Norway like Germany is strengthening its interest in local marine laboratories. During the past year (1892) it has succeeded in establishing two permanent stations, one near Bergen,—the other south of Bergen an outjutting point of the North Sea almost westward of Christiana. The former is interested especially in matters relating to the North Sea fisheries, and is supported partly by the contributions of a learned society and partly by a subsidy from the government in view of its relation to the practical fisheries. The second and smaller station is devoted almost exclusively to research in morphology. It is a dependency of the University of Christiana and is under the directorship of one of its professors, Dr. Johan Hjört.

With the richest collecting resources these new stations may naturally be expected to yield most important results.

Russians have ever been most enthusiastic in marine research, and their investigators are to be found in nearly every marine station of Europe. The French laboratory on the Mediterranean at Ville Franche, as has previously been noted, is supported essentially by Russians. At Naples they are often next in numbers to the Germans and Austrians. The learned societies of Moscow and St. Petersburg have contributed in no little way to marine research. The station at Sebastopol on the Black Sea, has become permanent, possessing an assured income. That near the Convent Solovetsky on the White Sea, though small, is of marked importance. It is already in its thirteenth year. Professor Wagner of St. Petersburg, has been its most earnest promoter as well as constant visitor. He in fact caused the Superior of the Convent to become interested in its work and secured a permanent building by the Convent's grant; he was then enabled by an appropriation from government to provide an equipment. Its annual maintenance is due to the Society of Naturalists of St. Petersburg. The matter of the appointment of a permanent director for the summer months is now being agitated. The station Solovetskaia is said to possess the richest collecting region of the Russian coasts. It is certainly the only laboratory which has at its command a truly Arctic fauna.

The following list of papers relating to marine laboratories was kindly sent the writer from Naples by Mr. H. B. Pollard.

Arcachon (Bulletin of the Scientific Society.)

Berichte v. d. Ver der. biol. Stat. Sebastopol. Russian text.

Brunchorst, Die biol. Meerestat. 1st. Bergen. Plate and plans.

Buissent, Les Stations Zool. du Bords de la Mer. Rev. de Ques. Scien. Brussels, 1889.

Dohrn, Aus Vergang. u. Gegenwart der Zool. Stat. in Neapel, Deutsche Rundschau, XVIII, h. II, Pactel, Berlin, 1892.

Fausseck, Station biologique "Solovetskaia." (1892.)

Herdman, Annual reports of Liverpool M. B. Station on

Puffin Island. Dobb & Co., Liverpool, 1890–91.

Hoyle, Scot. M. Stat. and its work. J. of M. B. Ass. II.

Korotheba, (The laboratory at Ville Franche, Russian text.) Cracow, 1892.

Lacaze Duthiers, Les Lab. maritimes de Roscoff et Banyuls en 1891. Rev. Exp. de Biol. 1892.

Les Stations Zoologiques, L' Aquarium des Sables d' Olonne, La Nature, 16 Annèe, 1 sem. 1891.

McIntosh, St. Andrew's Marine Laboratory. J. of M. B. Ass, II.

Mitsukeori, The Mar. Biol. Stat. of the Imp. Univ. at Misaki, J. of Col. of Scien. of Japan. Tokio. V. I.

Nederlandische Dierkundige Vereein Zool. Stat.
Tijdschr. d. Ned. Dier. Ver., with figure, 1890.

Petersen, Danske Biol. Stat. Rep. Copenhagen Schule. 1892.

Pouchet, Rapport. sur la Laboratoire de Concarneau, 1886.

Prince, St. Andrew's Mar. Lab. Eng. Ill. Mag. p. 70. 1889.

Vogt, Les Laboratoires de Zoologie maritimes, Rev. Scient. Paris, 1876.

Vogt, Zool. Stat. Die Gegenwart. 26 Bd. 1884.

Von Lendenfeld, Die Zool. Stat. in Trieste.
Oes. Ung. Revue, 7 Bd. 1889.

Zacharias, Forschungsberichte aus der Biol. Stat. zu Plön, Friedländer, Berlin, 1893.

Since the above was in print, Prof. Lönnberg has given the writer many interesting details in regard to the Swedish Zoological Station on the west coast near the city of Gothenberg.

The Station has up to the present, under its founder and late director, Prof. Loven, admitted no foreigners.

Its three original buildings, a laboratory and two dwelling houses, were constructed about fifteen years ago by a gift of Dr. Regnell of Stockholm. It is at present maintained by a small subsidy from the government. Dr. Hjalmar Theel, in charge of the museum at Stockholm, has recently been appointed its director. The laboratory is itself a wooden building, with aquaria rooms, and on the second story with the separate work places of the investigators. The students are mainly from the University of Upsala.

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

By Clarence Bloomfield Moore.

(*Continued from July Number,* 1893.)

(*Fourth Paper.*)

MULBERRY MOUND (ORANGE COUNTY).

By referring to the map accompanying the first article of this series,[1] the reader will see that Mulberry Mound lies on the west bank of the St. John's, just north of the river's exit from Lake Poinsett. Rising abruptly from the water's edge the mound offers the only solid footing for miles around, and upon it the otter hunter on his way up and down the stream finds a welcome refuge. This island mound has been under cultivation in former years, but when visited (February, 1892, and February, 1893) was covered densely with vines, shrubbery and sugar-cane. In all, eight days were spent in investigation with a party of eight workers. The mound extends from S. S. E. to N. N. W. The length of base is 285 feet; its maximum breadth 120 feet; its maximum height from water level at a low stage of the river is 15 feet, 6 inches. Shell continues to an undetermined depth. The mound is unstratified, as a whole, and is composed mainly of uniones with a large admixture of sandy loam, containing occasional ampullariæ and paludinæ.

At no part of the mound investigated by the writer was there any evidence of the presence of loose masses of shell comparatively unbroken. Abandoned fire places were found at every depth. Upon the surface is a stratum of loam and sand from 1½ feet to 2½ feet in thickness. This layer is probably a formation subsequent to the abandonment of the mound by the eaters of shell-fish, and all articles found therein cannot with certainty be attributed to the period of the formation of the shell heap.

---

[1] American Naturalist, Nov., 1892.

To the north of the shell heap is a small burial mound which, through its immediate association with the shell heap, is of the greatest interest. To it a number of additional days were devoted.

Of all the shell heaps of the St. John's, Mulberry Mound most richly rewards archeological research. So distant is the nearest solid ground and so contracted were the quarters of those who raised the shell heap that every article cast away or lost during certainly a very long period is contained within an area a mere fraction in comparison to that of many shell heaps of the lower river.

On the summit of Mulberry Mound, not far separated, three excavations were made: 10½ x 7 x 12 feet deep; 12 x 7½ x 10 feet deep; 16 feet, 8 inches by 14 feet, 5 inches by 16 feet deep. All these excavations were subsequently increased in size by the use of the pick upon the sides.

Pottery.

While the sherds found throughout the excavations were of good quality and ornamented fragments of pottery were found even below water level, yet in numbers and in variety of design they by no means compared with the fragments of ruder material so plentifully met with in other shell heaps of the river and notably at Tick Island and at Orange Mound. No sherds were encountered of that coarse and porous material showing original intermixture of vegetable fibre save two or three specimens at the very base of the mound. At a distance of 8½ feet from the surface was a fragment of pottery, colored a bright red, and three other sherds similarly decorated were encountered in various stages of the excavations. While pottery of this character is of frequent occurrence in the sand mounds its discovery is not on record hitherto in the shell heaps of the river. Pottery with stamped decoration, so common on the surface along the St. John's, was fairly abundant in the upper portion of the mound, while specimens were met with at unusual depths, one sherd thus decorated being found at a distance of 10 feet from the surface. As a rule, the ceramic ornamentation consisted of incised lines, several of novel pattern. One specimen showed interior decoration, the outer surface being plain. Another had been scratched upon the surface subsequent to the completion of the pottery (Fig. 1).

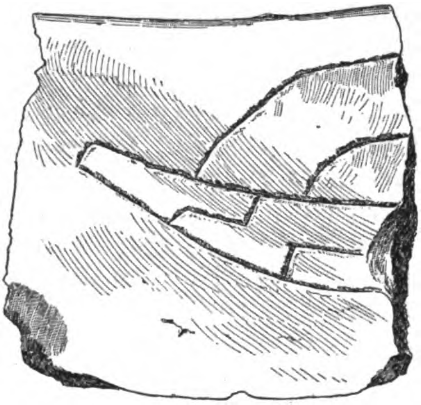


Fig. 1. (Full size.)

Three feet from the surface, in excavation 3, a vessel was uncovered, uninjured, with the exception of a small chipping from a portion of the rim. The material was of inferior quality. Its decoration varied, consisting of lines and dots in various combinations. The body of the bowl was plain. Its diameter at the mouth which was irregular but nearly circular, was from 8¼ inches to 7¾ inches. Its height was 4 inches. Its average thickness of material was .3 of an inch. In form it resembled a bowl, a common shape in the sand mounds.

Various partially broken vessels were found unornamented and presenting no peculiarity. One contained a mass of unbaked clay.

Nine and a half feet from the surface was found what at the time was considered a fragment of a large bead of pottery (Fig. 2), and not until two similar and more complete objects were met with in the adjoining burial mound (Figs. 3 and 4) was the conclusion arrived at that it was a portion of a tobacco pipe.

It will be remembered that the absence of pipes from the shell heaps was emphasized by Professor Wyman, and the writer, in upward of eighty shell heaps carefully explored, has heretofore found nothing indicating the use of tobacco by the eaters of shell fish, though pipes have been taken by him from the burial mounds. A careful comparison, however, of the figures given herewith should convince the most skeptical that all three are fragmentary parts of vessels used in the smoking of tobacco, and such is the opinion of Professor Haynes who has made a careful examination of the specimens.

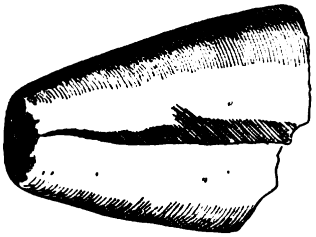


Fig. 2. (Full size.)

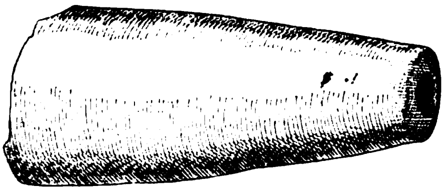


Fig. 3. (Full size.)

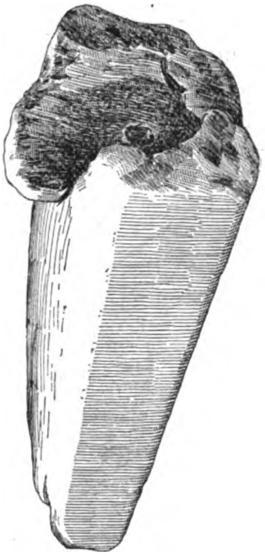


Fig. 4. (Full size.)

During the excavation a mass of baked clay was found bearing the imprint of human fingers.

At a depth of 2½ feet was found a mass of clay about six inches in height, unbroken, resembling half the cast of a pot. It is quite evident that whatever its use may have been, clay could readily have been moulded around it when placed with one of similar proportions.[2]

[2] It is possible that the masses of clay referred to by Squier and Davis (Ancient Monuments of the Mississippi Valley, page 149) were of similar character.

An Attempt at Delineation.

At a depth of 10 feet from the surface two pieces of pottery in immediate association were thrown out in the same shovelful of debris. An investigation showed the fragments, which were covered with the soot so frequently found upon the sherds of the shell heaps, to belong to the same vessel, though the fracture was contemporary with their abandonment in the mound. Upon them was rudely cut a representation of the human figure (Fig. 5).

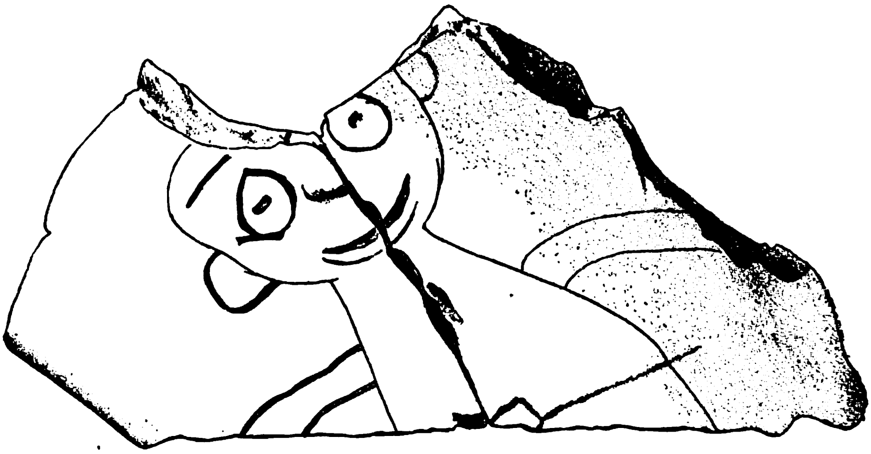


Fig. 5. (Full size.)

The discovery of this attempt at delineation at so great a depth in a shell heap of the river is of peculiar interest, being entirely unique in the extended search of the writer and unreported by others.[3]

Bone.

Upward of ninety implements of bone, many of which were somewhat fragmentary, were met with in the three excavations. As the depth of the excavations increased implements were found in an inverse ratio. Awls and piercing implements were numerous. One foot and five feet from the surface were two-pointed implements resembling daggers, respectively 6½ inches and 7¼ inches in length (Figs. 6 and 7). Piercing implements of bone of this size are not mentioned by Wyman, nor have they been met with by the writer in any other shell heap of the St. John's, though in the burial mound at Tick Island was found a carefully fashioned pointed instrument of human bone 9¼ inches in length, circled at the blunt end by an incised line. On one side were three perforations extending longitudinally below. These long stilletto-shaped implements of bone are not uncommon in other localities. Professor Haynes is of the opinion that they were used in the weaving of baskets.

---

[3] This aboriginal attempt at delineation may be seen at the Wagner Free Institute, Philadelphia.

At a depth of four feet was an implement, in shape resembling a shuttle (Fig. 8), hitherto unreported in connection with shell heaps in the river.

Two slender pins with lined ornamentation around the heads (Fig. 9), 7 inches and 8.2 inches in length, both discovered at a depth of three feet from the surface, though in separate excavations, were found intact, while throughout were numbers of small piercing implements two inches in length and over fashioned from the long bones of small carnivores with the articular portion remaining (Fig. 10). The core of a stag horn was lined with eight parallel circles.

A curious implement, 2.3 inches in length, was exhumed, made from a solid bone, unidentified, having a maximum diameter of 1 inch, polished at the base and drilled to a depth of .9 inch, the cavity diminishing slightly in size from the margin of the orifice inward. The opposite end was beveled on one-half to a central ridge, the other portion being cut down as if to connect with the cavity below. Two longitudinal parallel lines were on either side, while a longitudinal ridge spread out at the upper portion, forming a triangle of which the margin of the top formed the base. Unfortunately a series of figures would be required to represent this curious object.

A portion of the head of a piercing implement, 1⅝ inches in length was beautifully decorated with lines. Exposure to

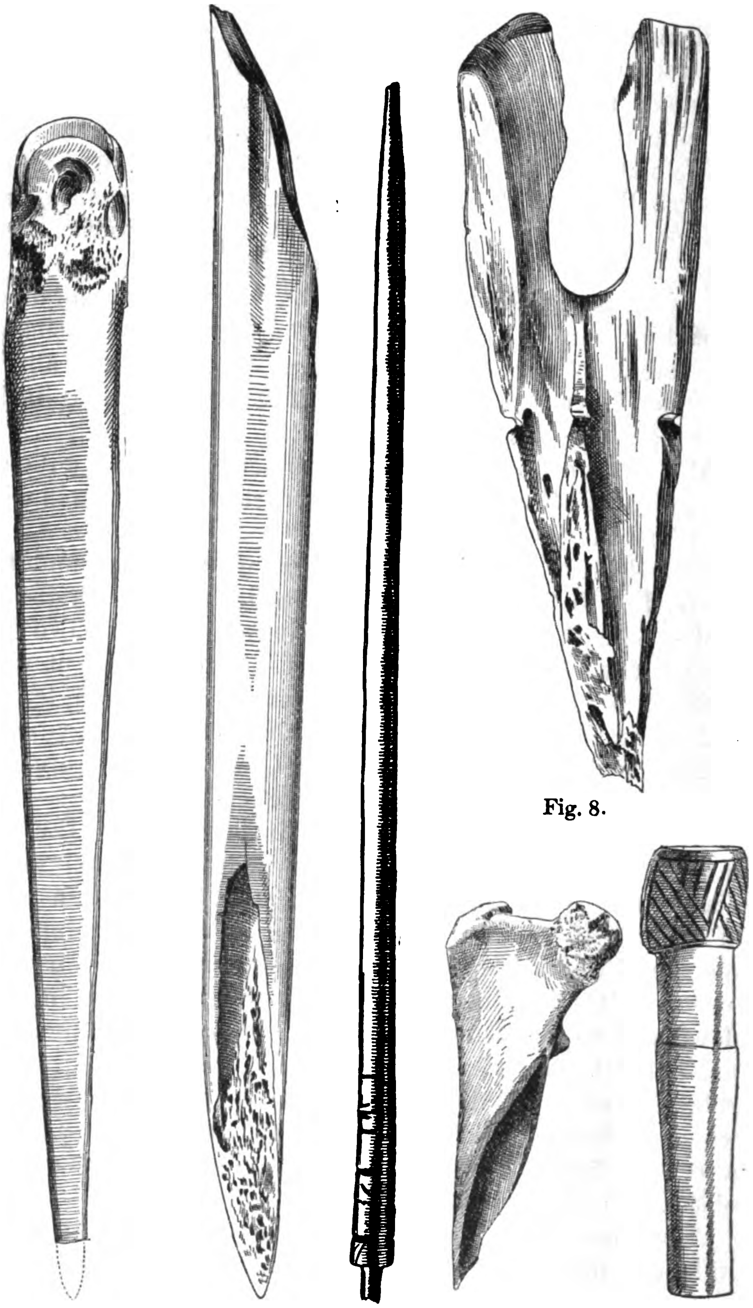


Fig. 6. Fig. 7. Fig. 8. Fig. 9. Fig. 10. Fig. 11.

Implements of Bone. (All full size.)

fire had colored it black and given to the surface a brilliant polish (Fig. 11).

Stone.

Just below the surface loam was a portion of a celt of slate, 2½ inches in length, polished and with ground cutting edge. Its depth does not identify it positively with the shell heap. 1½ feet from the surface was found a "sinker," or pendant ornament,[4] 2⅝ inches in length, rimmed at either end for suspension (Fig. 12). This interesting relic cannot positively be attributed to the period of formation of the mound. It is probable that later Indians cultivated the mound which, moreover, within recent years has been ploughed to facilitate the planting of sugar-cane.

Two feet from the surface a round sandstone hone was met with.

At a depth of 4½ feet was brought to light a celt of polished shale of rude workmanship, with the portion farthest from the cutting edge roughened, probably for insertion into a socket (Fig. 13). This find is extremely interesting, being the tfirs on record of an implement of polished stone found in a shell heap of the St. John's at a depth to justify the belief as to an origin contemporary with the heap. Among other articles of interest brought to light were a sandstone hone, grooved through the sharpening of pointed implements, and a flat piece of coquina.

At a depth of 14 feet, 8 inches from the surface was found a lance head of fine chert, 3.6 inches in length, thin and of graceful pattern, while 8 inches above were two lance heads of chert, one of beautiful design, barbed and having the base of the tang concave, fully as graceful in design and in finish as any stone point met with on the surface. Its length was 3.8 inches.

Its companion was of coarse yellow chert, with a length of 4.14 inches, and had a natural defect through crystallization of the material. It was of ruder workmanship. The great rarity of implements of stone in the shell heaps was commented upon by Wyman, and the writer during his investigations has had no grounds to differ from Professor Wyman's opinion. The discovery of lance points at such a depth and of such graceful pattern is entirely without precedent. Specimens of the rude and thick arrow points ordinarily found in the shell heaps will be figured in a later paper.

---

[4] Positive identification as to material has been found impossible without mutilation of specimen.

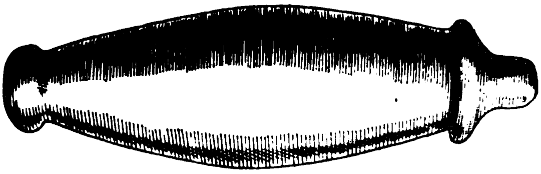


Fig. 12. (Full size.)

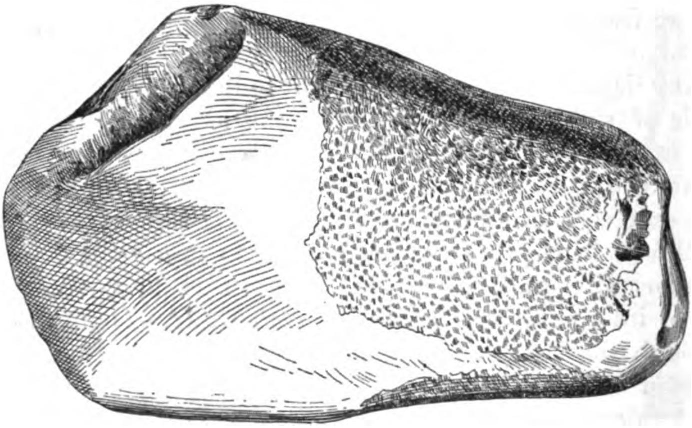


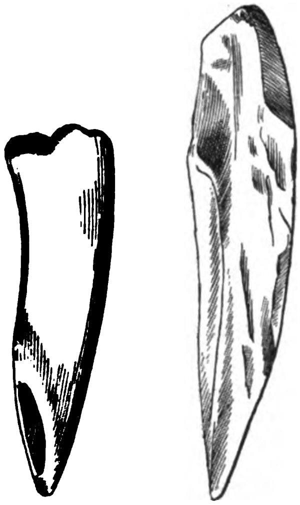
Fig. 13. (Full size.)

Throughout the excavations were found a number of pieces of red hematite, the largest being 3½ x 2⅝ x 2 inches. This mineral was largely used as coloring matter in several of the burial mounds, notably at Mt. Royal where the whole upper stratum is dyed with it.

Shell.

As in the case of implements of bone, so of shell it may be said that Mulberry Mound among all the shell heaps of the St. John's has furnished the richest results to the archeologist.

At every depth were found gouges and scrapers of shell, many unbroken, and columellæ of fasciolaria, one 10½ inches in length. Two and a quarter feet and five feet below the surface were found two drinking cups, formed from fulgur *perversum,* with portions of the side and the inner whorls removed, a form common enough on the surface and in the burial mounds, but very unusual at any depth in the shell deposits. Curiously enough, similar drinking cups wrought from the conch are in use to-day by the side of springs in some of the sea-board southern states.



Piercing Implements of Bone.
Mulberry Mound (full size).

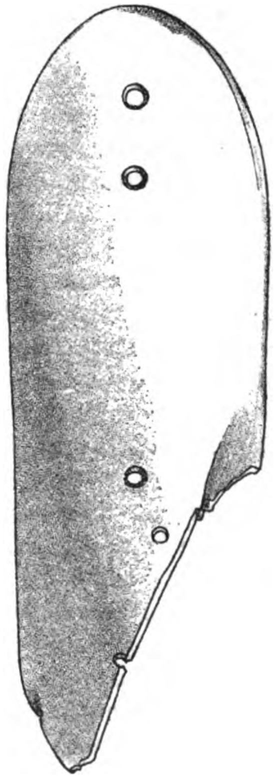


Fig. 14. ⅔ size.

Ten feet from the surface in perfect condition was a beautiful chisel fashioned from the lip of *strombus.*

Five feet from the surface was found a *cardium,* unbroken, but giving evidence of wear upon the edge, and having a portion of the shell between the ridges removed. A *pecten*, without wear or work upon the edges, is figured in the annual report of the Bureau of Ethnology, 1880–1881, Plate XXI, Fig. 3. This particular shell is described as having served among the Indians as a receptacle for paint, and as coming from Santa Barbara, California. It is possible that the "cockle shell" from Mulberry Mound may have been used for the lining of pottery. At all events, the two central ridges could be put to such a purpose.

At a depth of 13 feet, 8 inches was found a portion of a gorget of shell, the part recovered being 6.04 inches in length, 2 inches in breadth, with an average thickness of .12 inch (Fig. 14). It bore three perforations for suspension or for attachment, and two smaller ones along the line of fracture, evidently corresponding with similar ones on the missing portion, arranged to allow of repair by binding, a method common at that period. The discovery of a gorget or any object of personal ornamentation is so unusual in a shell heap of the St. John's that particular stress deserves to be laid upon it. In fact, with the exception of one longitudinally perforated phalanx of a deer, from Salt Run (Marion Co.), no articles of personal adornment have been found by the writer in any shell heap of the St. John's beyond the limits of Mulberry Mound.[4]

At various distances from surface, one even so deep as 11 feet, were found six fulgurs, five of the species *carica* and one *perversum*. All were ground at the beak, and all with the exception of one carica, were perforated. Three of the species *carica* had single perforations below the angle and involving it, and one on the body whorl between the angle and the suture within an inch of the aperture.

The fulgur *perversum* had a small round perforation above the angle and two, one ¼ inch, the other ⅞ inch, below. These perforations were considerably larger than the one above. The finding of the perforated fulgurs at so great a depth in a shell heap will, with other matters relating to these perforated shells, be referred to in Note A.

Human Remains.

Eleven feet from the surface, in immediate association with fragmentary bones of the lower animals, lay a portion of the shaft of a human femur 3¾ inches in length, with old breaks at either end; a portion of the shaft of a tibia, broken in excavation; two right heel bones, somewhat crushed; two bones of the toe; a fragment of a radius with old break, and a portion of rib. Five feet east of these remains lay a fragmentary portion of human femur, showing no recent fracture, while at the same level, but four feet distant, in the southeast corner of excavation 3 lay a fragment of femur; an ulna in two portions, old break; a small fragment of lower jaw and a piece of femur with old longitudinal split. At about the same level in the northwestern portion of the excavation, apparently entirely isolated, was the upper half of a human ulna. In view of the scattered and broken condition of these bones and their association with the bones of animals used for food together with the fact that an almost contiguous burial mound offered a means of sepulture, it seems unlikely that these human remains are other than refuse left over from a cannibalistic repast. Never elsewhere on the St. John's has the writer come upon human remains in this condition at a depth from the surface greater than 3 feet, and in his introductory paper, written previous to a second visit to Mulberry Mound, he stated that in view of the numerous cases indicating cannibalism discovered by him along the greater portion of the river where shell heaps exist, at no great depth from the surface, he was inclined to the belief that the custom must have come in at a somewhat late period of the formation of the shell heaps. Subsequent research may prove this supposition unfounded, but for reasons to be mentioned later the presence of human remains in this condition in Mulberry Mound does not modify his previously expressed opinion.

Remains of Lower Animals.

As is the case in the majority of shell heaps, the deer and turtle in Mulberry Mound were found, next to shell fish, to have been the most staple articles of diet. In addition to a number of small fragments unidentified, were found bones of the alligator, of the raccoon, of the turtle, of the black bear, of the red lynx (a jaw), of the catfish and of the gar. Also a curious bone identified by Professor Cope as supporting the dorsal fin in a member of the sheep's head family. The jaw of the red lynx, an animal hitherto unreported in the shell heaps of the St. John's, was submitted to Professor Cope for identification.

Note A.

Perforated Fulgurs.

The fulgur, sometimes termed the busycon, popularly known as the conch, was a shell extensively in use among the aborigines. If specimens of the two species of fulgur most commonly found on the St. John's River are held facing the investigator the shell having the aperture to his right is termed *carica*, to his left, *perversum*. Fulgurs with artificially ground beaks and with circular or oval perforations evenly made are comparatively numerous upon the surface of the territory bordering the St. John's River. They are seldom at a greater depth in the shell heaps than can be reached by the plow. Their superficial position was noticed and commented upon by Wyman (Fresh Water Shell Mounds of the St. John's River, Florida, page 58 and Plate VIII, Fig. 2). They are, however, occasionally found in the burial mounds of sand at depths excluding the idea of an intrusive deposit.[5] With the exception of Mulberry Mound, no shell heap in the writer's

---

[4] Wyman figures two perforated objects from the shell heaps, and the writer has a considerable number of the phalanges of the deer perforated longitudinally, ploughed up and presented to him by Mr. Charles Dillard of Volusia. He is also indebted to Mr. McAllister of Bluffton, Volusia Co., for the fossil tooth of a shark, perforated laterally, found superficially in the shell deposit at that place.

[5] This is particularly true of the great mound at Mt. Royal, Putnam Co., where in one trench among a number made, no less than 1307 fulgurs were found by the writer. A very small percentage, however, were evenly perforated in the manner of the shells under discussion. The great majority were of the species perversum. Some were unbroken, but the greater number were apparently intentionally mutilated in the manner of mortuary pottery by having a piece roughly knocked out.

investigations has yielded perforated conchs at a considerable depth, and as the territory bordering the St. John's has been carefully searched by the writer, having in mind the investigation of these perforated fulgurs, he is strongly inclined to the belief that the employment of these implements came in at a period subsequent to or approaching the abandonment of the great majority of the shell heaps of the river.

The use of these perforated fulgurs is not determined. Wyman confessed himself in doubt. In "Art in Shell," Bureau of Ethnology, Annual Report, 1880–1881, Professor Holmes figures a perforated fulgur (Plate XXVII) and cites Rau, "Archæological Collection of the National Museum," page 67: "It further appears that the Florida Indians applied shells of the *busycon perversum* as clubs or *casse-tetes* by adapting them to be used with a handle, which was made to pass transversely through the shell. This was effected by a hole pierced in the outer wall of the last whorl in such a manner as to be somewhat to the left of the columella, while a notch in the outer lip, corresponding to the hole, confined the handle or stick between the outer edge of the lip and inner edge of the columella. * * * * A hole was also made in the posterior surface of the spire behind the carina in the last whorl, evidently for receiving a ligature by means of which the shell was more firmly lashed to the handle."

Of scores of perforated fulgurs from the river, examined by the writer, he can recall but two wrought from the fulgur *perversum.* The fulgur *carica* is a more massive shell and better fitted for the rough work than the more slender *perversum* from which shell the drinking cups of the river shell heaps and mounds are fashioned. It is true that a heavy variety of *perversum* is met with on the coast, and that the fulgur *carica* is rarely, if ever, found on the west coast or on the east coast south of Jupiter inlet.[6]

In the coast shell heaps alone is the perforated fulgur *perversum* found to any extent, and this point should be remembered when perforated fulgurs of Florida are under discussion.

---

[6] The Academy of Natural Sciences possesses no fulgurs of the species carica from the west coast. The Smithsonian has one, stated to be from Cedar Keys; its record is not well established.

In the river shell heaps a very small percentage of perforated shells have a notch in the outer lip, while absolutely none has a perforation in the spire, if we consider the spire to be that portion of the shell surrounding the apex, bounded by the suture. Moreover, a considerable majority of the perforated shells have but one hole, that being in the body whorl between the angle and the suture, from one to two inches to the right of the aperture. A certain percentage of fulgurs have the perforation below the shoulder, or angle, but frequently in such a position that if hafted, the ground beak of the shell would not be at right angles with the handle, and occasionally the perforation is so placed that a handle entering the aperture could not reach it. In other cases, perforations are disproportionately small and oval in shape, unfitted to receive a handle suitable for the rough usage of a war club. In the writer's collection are two good sized fulgurs with perforations .54 inch by .76 inch, and .86 inch by .56 inch. Many perforated fulgurs with ground beaks are of a size to set aside the hypothesis of their employment for any purpose where weight is an important factor. Of these the writer has one weighing but eight ounces, while another is but 2¾ inches in length. Occasionally fulgurs are seen with perforations in the body whorl above and below the shoulder, and it is probable that these are the ones referred to by Rau with a misapprehension as to the location of the spire. Again, other fulgurs are found with a single perforation between the angle and the suture, having two below the shoulder and equidistant from it. A fulgur *perversum* of this character, was taken by the writer from the historic mound at Mt. Royal, Putnam County.

Some fulgurs with ground beaks are imperforate, while others with perforations show grinding or wear where not alone the beak is involved but a portion of the lip. Other shells give evidence of considerable wear on the margin of the perforation toward the upper and lower portion of the shell, showing that the implement was not securely hafted and that it was subjected to continuous use. Others are polished on e spire and body whorl above the periphery as though held the hand.

From all this it is evident that while certain perforated ful-rs may have served for war clubs the great majority did t. Mr. Douglass, who is so familiar with the east coast of orida, believes some of them to have served as hoes, and in s he is doubtless right. Probably, as is the case with most original implements, their use was various.

Conclusions.

At no point in the excavations at Mulberry Mound were nole shells found in any numbers, the heap having grown parently from the beginning by the slow accretion of refuse m the meals of the few families living upon it and been idly packed beneath their feet. It is apparent that such ould be the case, since solid ground is too far distant to mit of the hypothesis that the mound was made through ntributions of others not living upon its immediate surface. at a considerable time was required to pile so great a mass shell to such a height through the agency of comparatively there can be no reason to doubt. And yet the writer is nvinced that of all the shell heaps investigated by him and Professor Wyman the shell heap at Mulberry Mound is the st recent, and that it was still in process of formation when ny others were abandoned, at least for use as refuse heaps. is belief is based upon the marvelous variety of the imple-nts of bone, so infrequent in the other mounds, and patterns retofore unreported from other localities on the river. The esence of delicately wrought lance heads near the base; of lored and of stamped pottery at considerable depths; of ful-rs at a distance from the surface; of a carefully made gor-t of shell; the discovery of an implement of polished stone, a t previously unheard of in the river shell heaps, and frag-ntary human bones a number of feet from the surface, nd only superficially by the writer in numerous other shell aps, when taken together, argue for Mulberry Mound origin posterior to other shell heaps of the St. John's hith-to explored. It will be noted, however, that nothing found this shell heap indicated a knowledge of Europeans or in y way pointed to its formation in post-Columbian times.

RECENT BOOKS AND PAMPHLETS.

Ayers, H.—The *Macula neglecta* again. Extr. Anat. Anzeig. VIII Jahr., 1893. From the author.

Boettger, O.—Ubersicht der von Prof. C. Kellar anlässlich der Ruspoli'schen Expedition nach den Somaliländern gesammelten Reptilien und Batrachier. Extr. Zool. Anz., 1893. From the author.

Brendel F.—Flora Peoriana. Peoria, 1887. From Frederick Boettger.

Brower, J. V.—The Source of the Mississippi River [Official Record]. From the author.

Buckmann, S. S.—Some Laws of Heredity, and their application to Man. Extr. Proceeds. Cotteswold Nat. Field Club. Vol. X, Pt. 3, 1891-92. From the author.

Catálogo de los Objectos Etnológicos y Argueológicos exhibidos for la Expedicion Hemenway. Madrid, 1892.

Chapman, H. C.—The Interpretation of Certain Verses of the First Chapter of Genesis in the Light of Paleontology. Extr. Proceeds. Phila. Acad. Sci., Feb. 1893. From the author.

Cross, W.—Notes on the Associated Igneous Rocks of the Hematite and Martite Iron Ores in Mexico. Extr. Am. Journ. Sci., Vol. XLV, Feb. 1893. From R. T. Hill.

Davenport, C. B.—Note on the Carotids and the Ductus Botalli of the Alligator.

——On *Urnatella gracilis.* Extrs. Bull. Harvard Mus. Comp. Zool., Vol. XXIV, 1893. From the author.

Day, D. T.—Report on the Mineral Resources of the United States for 1891. From the U. S. Geol. Survey.

Diller, J. S.—Cretaceous and Early Tertiary of Northern California and Oregon. Extr. Bull. Geol. Soc. Am., Vol. 4, 1893. From the Society.

Dumble, E. T.—Volcanic Dust in Texas. Extr. Trans. Texas Acad. Sci., 1892. From the author.

Eigenmann, C. H.—The Percopsidae on the Pacific Coast. Extr. Science, Oct. 1892. From the author.

Fish Commissioners, A Correct List of. From the Chicago Field. No date.

Fourth Annual Report of the Missouri Botanical Gardens, 1893. From the Trustees.

Gage, S. H.—Notes on Fibrin Oxyhaemoglobin Crystals, and the Collodion Method. Extr. Proceeds. Am. Soc. Micros., 1891. Methods of Decalcification in which the Structural Elements are Preserved. An Aqueous Solution of Hematoxylin which does not readily deteriorate. Extr. Proceeds. Am. Micros. Soc., Vol. XIV, 1892.

——Address before the Section of Biology, A. A. A. S., Aug., 1892. Extr. Proceeds. A. A. A. S., 1892. From the author.

Hague, A.—Geology of the Ureka District, Nevada. Monographs of the U. S. Geol. Surv., Vol. XX. From the U. S. Geol. Survey.

Herrick, C. L.—Mammals of Minnesota. Bull. No. 7, Geol. and Nat. Hist. Surv. Minn., 1892. From the author.

HOLMES, W. H.—Are there traces of Man in the Trenton Gravels. Extr. Journ. Geol., Vol. I, No. 1, 1893. From the author.

HOWORTH, H. H.—The Glacial Nightmare and the Flood. Vols. I and II. London, 1893.

HILL, R. T.—The Cretaceous Formations of Mexico and their Relations to North American Geographic Development. Extr. Am. Journ. Sci., April, 1893.

——The Geologic Evolution of the Non-Mountainous Topography of the Texas Region. An Introduction to the Study of the Great Plains. Ex. Am. Geol. Vol. X, 1892.

——The Occurrence of Hematite and Martite Ores in Mexico. Extr. Am. Journ. Sci., XLV, Feb., 1893. From the author.

MELL, P. H.—Report on the Climatology of the Cotton Plant. Bull. No. 8, Weather Bureau. From the author.

MILLER, G. S.—A Jumping Mouse (*Zapus insignis* Miller) New to the United States. Extr. Proceeds. Biol. Soc. Washington, Vol. VIII, 1893. From the author.

MITCHELL, S. WEIR.—The Early History of Instrumental Precision in Medicine. An address before the Second Congress of American Physicians and Surgeons, Sept., 23, 1891. From the author.

North Carolina Agri. Exp. Station. Bulletin Nos. 88, 89, 90, 1893.

OSBORN, H. F. AND J. L. WORTMAN.—Fossil Mammals of the Wahsatch and Wind River Beds. Collection of 1891. Extr. Bull. Am. Mus. Nat. Hist., Vol. IV, 1892. From the authors.

PECKHAM, G. W. AND E. G.—Ant-Like Spiders of the Family Attidae. Extr. Papers Nat. Hist. Soc. Wisconsin, Vol. II, 1892. From the Milwaukee Museum.

PEPPER, WM.—The Relation of Undergraduate to Post-Graduate Curricula. An address read before the National Educational Association at Saratoga, July 12, 1892. From the author.

PROSSER, C. S.—The Thickness of the Devonian and Silurian Rocks of Central New York. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893, p. 91. From the author.

Report of the Commissioner for 1888. United States Commission of Fish and Fisheries, Part XVI. Washington, 1892. From the U. S. Fish. Comm.

RHOADS, S. N.—The Birds Observed in British Columbia and Washington During Spring and Summer, 1892. Extr. Proceeds. Phila. Acad. Sci., 1893. From the author.

Resolutions of the Australian Association for the Advancement of Science Concerning an International Committee on Biological Nomenclature. Extr. Proceeds. Am. Ass. Adv. Science, Vol. XLI, 1892.

SAUVAGE, M. H. E.—Recherches sur les Poissons du Lias Supérieur de l' Yonne Zone a Ciment de Vassy. Extr. Bull. Soc. d'Hist. Nat. Autun, 1892.—Note sur quelques Poissons du Lias Supérieur de l' Yonne. Extr. Bull. Soc. Sci. de l' Yonne, 1891. From the author.

SCLATER, W. L.—On Some Specimens of Frogs in the Indian Museum, Calcutta, with Descriptions of Several New Species. Extr. Proceeds. London Zool. Soc., 1892. From the author.

SHALER, N. S.—The Conditions of Erosion Beneath Deep Glaciers, Based Upon a Study of the Boulder Train from Iron Hill, Cumberland, R. I. Extr. Bull. Mus. Comp. Zool. Harv. Coll., Vol. XVI, 1893. From Alexander Agassiz.

SHUFELDT, R. W.—Comparative Osteological Notes on the Extinct Bird Ichthyornis. Extr. Journ. Anat. and Physiol. Vol. XXVII. From the author.

SLINGERLAND, M. V.—The Pear-Tree Psylla. Bull. 44, 1892. Cornell Univ. Agri. Exp. Station. From the author.

STEVENSON, J. J.—Prof. I. C. White's Stratigraphy of the Bituminous Coal Field of Pennsylvania, Ohio and West Virginia. Extr. Am. Geol. June, 1892.

——Some Notes on South-Eastern Alaska and its People. Extr. Scottish Geog. Mag., Feb., 1893. From the author.

TOWNSEND, C. H. T.—On a Leaf-Miner of *Populus fremonti*. Notes on Two Mexican Species of Ceroplastes, with a Record of Parasites Reared from One. Extr. Zoe, Oct., 1892. New Jamaica Tachinidae.—New North American Tachinidae. Extrs. Entomol. News, 1892. From the author.

TRELEASE, WM.—Further Studies of Yuccas and their Pollination. Extr. Fourth Ann. Rept. Missouri Botanical Gardens, 1893. From the author.

UPHAM, W.—Comparison of the Pleistocene and Present Ice-Sheets. Extr. Bull. Geol. Soc. Am. Vol. IV, 1893, p. 191. From the author.

WHITEAVES, J. F.—Contributions to Canadian Paleontology. Vol. I, Pt. IV, 6. The Fossils of the Devonian Rocks of the Islands, Shores or Immediate Vicinity of Lakes Manitoba and Winnipegosis. Ottawa, 1892.

——Notes on the Gasteropoda of the Trenton Limestone of Manitoba, with a description of one new species. Extr. Canadian Record Science, April, 1893. From the author.

WOLF, J. E. AND R. S. TARR.—Acmite Trachyte from the Crazy Mountains, Montana. Extr. Bull. Harv. Mus. Comp. Zool., Vol. XVI, 1893. From Alexander Agassiz.

RECENT LITERATURE.

Hawks and Owls of the United States.[1]—This volume is a report on the Hawks and Owls of the United States, by Mr. A. K. Fisher, with reference to the economic status of the various species. Of it Mr. C. Hart Merriam makes the following statement in his letter of transmissal to the Secretary of Agriculture.

"This work was written several years ago, but was withheld from publication until provision could be made for suitable reproduction of the colored illustrations, without which the bulletin would have been of comparatively little value to the class of readers for whose benefit it was specially prepared.

"The statements herein contained respecting the food of the various hawks and owls are based on the critical examination, by scientific experts, of the actual contents of about 2,700 stomachs of these birds, and consequently may be fairly regarded as a truthful showing of the normal food of each species. The result proves that a class of birds commonly looked upon as enemies to the farmer, and indiscriminately destroyed whenever occasion offers, really rank among his best friends, and with few exceptions should be preserved, and encouraged to take up their abode in the neighborhood of his home. Only six of the 73 species and subspecies of hawks and owls of the United States are injurious. Of these, three are so extremely rare they need hardly be considered, and another (the Fish Hawk) is only indirectly injurious, leaving but two (the Sharp-shinned and Cooper's Hawks) that really need be taken into account as enemies to agriculture. Omitting the six species that feed largely on poultry and game 2,212 stomachs were examined, of which 56 per cent contained mice and other small mammals, 27 per cent insects, and only 3½ per cent poultry or game birds. In view of these facts the folly of offering bounties for the destruction of hawks and owls, as has been done by several states, becomes apparent, and the importance of an accurate knowledge of the economic status of our common birds and mammals is overwhelmingly demonstrated."

Fresh Water Algæ and the Desmidieæ of the United

---

[1] The Hawks and Owls of the United States in their Relation to Agriculture. By A. K. Fisher. Bull. No. 3, Div. Ornith. & Mam., U. S. Dept. Agric., Washington, 1893.

States.[2]—This work of Mr. Stokes has been prepared with special reference to the needs of beginners in the study of Algæ and Desmids, for whom the author believes analytical keys are absolutely essential. Generally speaking an artificial one is more useful than a natural one which involves more or less dissection, ruinous to the specimen, and a knowledge of characters that a beginner does not possess.

The keys offered by Mr. Stokes are founded on the classification in Wolle's Monographs on the fresh water Algæ and Desmids of this country, and references to these works are given for extended descriptions of the species.

Directions for the collection, preservation and mounting of these microscopic plants are given, with a list of the best preserving media in the order of their excellence.

The plate illustrating the genera of Desmids is a valuable adjunct to the work.

Gasteropoda and Cephalopoda of the New Jersey Cretaceous Marls.[3]—This volume, in reality a Monograph of the subject, has been prepared by Professor Robert P. Whitfield for the Geological Survey of New Jersey. It constitutes the second volume of a series which is intended to include descriptions of all the fossil invertebrates found in the New Jersey Cretaceous Marls. The following is a synopsis of the Classified List which accompanies the work:

INVERTEBRATA OF THE NEW JERSEY CRETACEOUS MARLS.

Gasteropoda.

	Genera	Species
Subclass Prosobranchiata		
Order Pectinibranchiata	54	119
Order Scutibranchiata	5	6
Subclass Opisthobranchiata		
Order Tectibranchiata	6	6

Scaphoda.

Family Dentalium	3	4

---

[2] Analytical Keys to the Genera and Species of the Fresh Water Algæ and the Desmidieæ of the United States. By Alfred Stokes. Portland, Conn., 1893.

[3] Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. By Robert P. Whitfield. Trenton, 1892.

Cephalopoda.

Order Tetrabranchiata	8	21
Order Dibranchiata	1	1

INVERTEBRATA OF THE NEW JERSEY EOCENE MARLS.

Gasteropoda.

	Genera	Species
Subclass Prosobranchiata		
Order Pectinibranchiata	25	45
Order Scutibranchiata	2	4
Subclass Opisthobranchiata		
Order Tectibranchiata	3	3

Cephalopoda.

Order Tetrabranchiata	2	2

General Notes.

GEOGRAPHY AND TRAVELS.

Europe.—NEUSIEDLER LAKE.—Neusiedler Lake has for some time decreased in capacity, and it is now proposed to drain its remaining waters into the Raab by means of a canal.

RECLAMATION OF THE ZUYDER ZEE.—The March issue of the Geographical Journal contains an account of the engineering works proposed to be executed for the purpose of reclaiming the greater part of the Zuyder Zee. The work is to be carried out in sections, the first of which will fill in a bay north of the broad channel which will be left leading to the city of Amsterdam; while the second will comprise an extensive area south of that channel. The remaining sections will diminish the water area to the eastward. As a dam will be built across the Zee at its mouth the whole of the waters within will be fresh, and will be named the Ysel Meer, from the river of that name. The scheme also provides for the enlargement on their land-fronts of the islands at the mouth of the Zuyder Zee.

THE PONTINE MARSHES.—Capt. von Doncet has brought forward a scheme for reclaiming the Pontine Marshes, which are exceedingly fertile, and capable of producing food for half a million of people. The area is six square miles, but the exhalations from them render sixteen square miles unhealthful, and the present population is only thirty. The projector proposes to cut off by peripheral canals the streams which enter from the surrounding higher ground, and to utilize the existing interior canals, the work of Pius VI. The surface of these marshes is of old soft elastic peat, ten feet thick at the Appian Way, over seventy feet deep at the foot of the mountains; this peat apparently fills an ancient sea area, as beneath it is a layer of clay with shells and sea-sand. Five thousand acres are too low to permit the natural fall to be made available, and much of the area is, after the rains, covered with three feet of water, besides which, springs at the foot of the hills yield one and a half times as much as might be expected to drain into the basin.

Africa.—ASCENT OF THE JUB OR JUBA.—Capt. Dundas has returned safely from what seems to have been a most perilous journey of some 400 miles up the Juba, a river which parts the "sphere of influence" of England in East Africa from that of Italy. The inhabitants of both coasts of this river are the fanatical Mussulman, Somali or Swahili, who resent the coming among them of any European, though some of the coast Somalis seem to have become accustomed to their presence. At the very entrance of the river the natives assembled in great numbers, completely over-awed the crew of Zanzibaris, and gave Capt. Dundas to understand that he could not proceed without leave. The Captain was compelled to go to Mombasa, and enlist the aid of the resident there by whose tact leave was obtained, the Somal chief appropriating a sword and an armchair as a present. At about a hundred miles from the sea a second river channel, trending toward the ocean, south of the mouth known as that of the Juba, enters the latter stream.

New troubles commenced when the territory of the chief of Berbera, within which the unfortunate expedition of Van der Decken came to an end, was reached. Thousands of savages appeared on the banks, and many sprang into the river to seize the little stern wheel steamer. The discharge of a rocket cleared the river, but the danger remained. Accompanied by his interpreter, Capt. Dundas went ashore, and, constantly repeating "Aman" (peace) made his way, spite of the contact of cold spears, into the chief's presence. "We have done you no harm, is it to be 'aman' or not," was the substance of the Captain's speech. The astonished chief hesitated, asked for time to consider, and then sent word that, though he objected to white men, he rather liked the captain. Finally, with some natives on board, the *Kenia* was allowed to proceed, passing by the wreck of Van der Decken's vessel, to some rapids; whence, as the Somals assured Capt. Dundas that important falls existed a few miles higher up, and as the water was shallow, the *Kenia* commenced its return journey.

Capt. Dundas speaks with considerable admiration of the fighting powers and physique of the Somalis, who are attired with a long spear and a stabbing knife, and who guard their women rigidly. Many lighter complexioned Galla, probably slaves, were observed among them.

DAHOMEY—The end of General Dodd's victorious compaign in Dahomey has been the declaration that all that country is now under French protection, while the districts of Whydah, Godomy, Abomey—Kalavi, with some others, are annexed to France.

SOURCES OF THE NILE.—Dr. Bauman's journeys in the district between Lakes Tanganyika and Victoria Nyanza have thrown much light on the ultimate sources of the Nile. Dr. Bauman considers the

Kagera, a small river emptying into the Nyanza, as the true fount of the Nile—its source is esteemed sacred by the Warundi, or natives of Urundi, a thickly populated district lying around the head of Lake Tanganyika.

DEATH OF MSIDI.—The March issue of the Geographical Journal contains a résumé of the conduct and result of various exploring expeditions which have penetrated into the district of Garenganze (Msidi's country) since it was visited by Arnot. The whole of this southeastern part of the Congo State has been leased to the Katanza Company, and no less than five expeditions have reached and explored the upper courses of the Lualaba, Lomaine, and Sankaru, the upper part of which last is called the Lubilash. Lieutenants Paul le Marinel, Delcommune and Capt. W. G. Stairs were the respective commandants of three of these. The most important political event has been the death of Msidi, and the falling to pieces of his ephemeral empire. Having become old and despotic, various chiefs rebelled, and the country became anarchic. Msidi asked for aid from M. Delcommune, but that gentleman wisely refused. During the stay of Capt. Stairs at the capital, Lieut. Bodson was compelled to shoot at and kill Msidi in self-defence, but was at once shot by a chief. Capt. Stairs immediately called the chiefs together, and persuaded them to accept the flag of the Congo State. At this juncture—Captain Dia and his party arrived, and Capt. Stairs, whose health had long been failing, took the opportunity of departing for the coast, but died at Chinde. The flow of water in the Lualaba is much less that in the more eastern Lualaba. Msidi's "empire" about which so much has been written, has therefore endured less than a single generation.

The River Baram and Mt. Dulit, Borneo.—In the Geographical Journal for March, Mr. C. Hose gives an account of a trip up the Baram River to Dulit (5100 feet) and the high lands of Borneo. A map accompanies the account, and one eminence Kalalong is given at 7000 feet, while Mr. Hose states that the extinct summit visible must be nearly 10,000 feet. An amusing incident was the encounter with a musician who was entertaining an assembly by performing upon a flute, *selingut*, with his *nose*, and eliciting notes clearer than those obtaining from the ordinary native flute, *ensuling*, played with the mouth. The musician asserted that when at best, he could draw tears from his audience. The lower part of the Baram, which at its embouchure is three quarters of a mile wide, and which rolls forth a current sufficiently strong to render the sea-water fresh two miles from shore, is flat, with little to note save fine palm-trees. The first real high ground begins

60 miles from the mouth, at Claudetown, the seat of government and centre of trade. Most of the traffic seems to be in the hands of Chinese merchants. At the entrance of the Akar the land is very fertile, and the mountain scenery fine; while at the mouth of the Libbun the scenery on one side consists of lofty table topped elevations of from 5,000 to 8,000 feet, on the other of grassy plains. The object of Mr. Hose's trip was not exploration only, but natural history, and from various points of the flat topped Mt. Dulit he collected many birds and mammals, some of the former new to science. Several tribes; Kayans, Punans, etc., are mentioned, all differing from the Dyaks. The Punans build no houses, but live in the jungle like wild beasts, and are expert with the blow pipe. The Kayans have singular burial customs, and are spiritualists, believing that messages can pass between the dead and the living. When a death occurs in a family, the body is placed in a coffin of soft wood, painted in various hues, and with a lid fastened down with dammar resin, and is kept in the house three months. To avoid too great a nuisance, a long drain of bamboo is thrust deep into the soil, with the upper end in the coffin. After three months a tomb of hard wood, twelve feet from the ground, adorned with figures of men and women, is made, and the corpse is borne to it with much ceremony. The weapons, tools, and cook-pot of a man are buried with him, while with a woman are laid her sun-hat, hoe, and personal adornments, particularly her ear-rings. Cigarettes, to be given to friends in the land of the dead, are always placed with the corpse. The Kayans believe that the dead have different places of abode, according to the manner of their death. Those who die of sickness or old age have a lot in Apo Leggān, much like that on the earth; those who die by accident or in battle have a better lot in Long Jalan; still born children, who have never known pain, are very brave; suicides are miserable in Jan Jokkan, while to those who die by water fall stores of riches in their posthumous residence Ling Yang. It may be remembered by some that recently Mr. Whitehead added greatly to our zoological knowledge of Borneo by his ascent of Kina Balu, from which mountain he brought back a collection that demonstrated the existence of a Himalayan fauna. Mr. Hose has added to these proofs. The district of the Baram River has been detached from N. Borneo, and annexed to Sarawak, now governed by the son of the famous Rajah Brooke.

Mr. H. R. Mill, in an article in the March Geographical Journal seeks to reconcile conflicting ideas respecting the permanence of oceanic and continental areas, by showing that the 1700 fathom line divides the world into two nearly equal areas, the one abyssal, the other continental.

GEOLOGY AND PALEONTOLOGY.

The Moon's Face.—Mr. Gilbert's address as retiring president of the Washington Philosophical Society is an ingenious array of arguments in favor of the impact theory to account for the origin of the features of the moon's face. His hypothesis is, that material constituting the moon once surrounded the earth in the form of a Saturnian ring; that the small bodies of this ring coalesced, first gathering around a large number of nuclei, and finally all uniting in a single sphere, the moon; that the lunar craters are the scars resulting from the collision of the moonlets.

This hypothesis reconciles the impact theory with the circular outline of the lunar craters, and explains the abundance of colliding bodies of large magnitude. The author discusses the probabilities of the formation, according to his theory, of lunar wreaths, central hills, arched inner plains, level inner plains, and the association of inner plains with central hills. He finds his theory adequate to explain all these phenomena, as well as the peculiarities known as furrows, sculpture, rills and rill pits. In regard to the "white streaks" Mr. Gilbert quotes, as in accordance with his own idea, an unpublished suggestion made by Mr. William Würdeman, "that a meteorite (moonlet) striking the moon with great force spattered whitish matter in various directions."

During the growth of the moon, many of the moonlets must have collided with the earth and formed impact craters which have been obliterated by erosion and sedimentation. It is possible the writer suggests, that these collisions imitated not only the differentiation of continental and oceanic plateaus, but the series of geographic transformations of which geologic structure is the record. (Phil. Soc. Washington, Bull. Vol. XII, 1893).

North America during Cambrian Time.—Mr. Charles Walcott's extensive knowledge of the Cambrian system of North America, has made it possible for him to reconstruct the form of the continent during that time. The land area is considered at the inception of Cambrian time, and its history is traced in a broad manner to the closing epoch of the period.

By a form of deductive reasoning from the mode of sedimentation the author first determines an approximate shore line of the ancient pre-Cambrian continent. The geographic distribution of pre-Cambrian land is based upon the evidence afforded by the absence of Cambrian deposits upon known pre-Cambrian rocks; the existence of shore lines during earlier Cambrian time; and the presence of deep-water deposits. The features of the surface of the pre-Cambrian land are indicated by the relation of the known Cambrian and post-Cambrian formations where it is exposed.

Mr. Walcott considers the prevailing view of the geographic distribution and extent of continental area at the beginning of Paleozoic time too restricted. The present Appalachian system was outlined by a broad, high range that extended from the present site of Alabama to Canada, with subparallel ranges to the east and northeast. The paleo-Adirondacks joined the main portion of the continent, and the strait between them and the paleo-Green Mountains opened north into the paleo-St. Lawrence Gulf, and to the south extended far along the western side of the mountains and the eastern margin of the continental mass to the sea that carried the fauna of the Olenellus epoch around to the paleo-Rocky Mountain trough.

It is highly probable that ridges of the Algonkian Continent rose above the sea to the east of the present continent. On the east and west of the continental area the pre-Cambrian land formed a mountain region, and over the interior a plateau existed much as it does to-day.

In late Middle Cambrian time, the Cambrian Sea began to invade the great Interior Continental area and extended far to the north toward the close of the period.

At the close of the Cambrian time the Cambrian Sea had extended over the broad interior continent and had submerged the low ground along the line of the barrier ridges and some portions of the northern nucleal V of the Archean Continent.

Two hypothetical maps based upon columnar sections, and the present knowledge of the distribution of the sediments, represent the continent at the beginning of Lower Cambrian and of Ordovician time. These maps in connection with one showing the relative amount of sedimentation within the typical provinces of North America during Cambrian time, and the theoretic sections across the continent, are valuable adjuncts to the text. (Extr. Twelfth Ann. Rept. Director U. S. Geol. Survey, 1890–91).

Lower Silurian Brachiopoda of Minnesota.—The report of Mr. N. H. Winchell and Mr. Charles Schubert on the Brachiopoda found in the Lower Silurian deposits of Minnesota comprises descriptions of 31 genera and subgenera, to which are referred 94 species and varieties. These latter include 15 that are new to science. Two new families are necessitated by the authors' scheme of classification. Clitambonitidæ to contain Protorthis, Clitambonites, Hemipronites, and Scenidium; and Lingulasmatidæ to contain Lingulaps and Lingulasma.

In a short introduction the authors state that near the top of the Trenton shales new forms are introduced. Near the middle of the Galena the brachiopod horizon is quite distinct from any below it. The fauna of the Hudson River deposits agrees with that of the Cincinnati group of the Ohio Valley. Below the Trenton limestone, but one brachiopod (*Lingula moesii*) is known in the St. Peter sandstone; none in the Shakopee formation, but several in the Lower Magnesian. In the St. Croix formation brachiopods are abundant but mainly of inarticulate species. (Extr. Vol. III. Rept. Minn. Geol. Surv. 1893)

Geological News. General.—Mr. C. S. Du Riche Preller gives as a result of a lengthy investigation of the Tuscan Archipelago that (1) these islands are, geologically and petrographically, closely connected, not only with each other, but with the Maremina Hills on the one hand, and with Corsica and Sardinia, as well as with the Ligurian Alps on the other; (2) that they probably constitute part of a former Tyrrhenian continent; and (3) with few exceptions they are representative of every geological formation from pre-Silurian downward and also include an interesting eruptive series. (Geol. Mag., June, 1893).

Paleozoic.—Mr. N. H. Winchell and C. Schubert have published in quarto form, with profuse illustration, the Sponges, Graptolites and Corals from the Lower Silurian of Minnesota. 9 sponges are listed; 4 Hydrozoa including the doubtful one, *Solenopora compacta* Billings; and 10 Actinozoa, of which 5 are new species. The paper includes a discussion of the systematic position of "Anomaloides" by Mr. E. O. Ulrich, with a proposal to change the name to Anomalospongia. (Vol. III. Final Rept. Minn. Geol. Surv. 1893).

A new species of Discites (*Discites hibernicus*) is described and figured by Messrs A. H. Foord and G. C. Cricks in the Geol. Mag., June, 1893. The shell has not been distorted during fossilization, so that the characters of the fossil can be accurately determined. The specimen was found in the carboniferous limestone near Dublin.

According to Mr. Arthur Hollick the isolated and limited exposures of cretaceous strata on Staten Island indicate a large and continuous bed of similar material throughout the entire area. Mr. White's division of the New Jersey cretaceous strata into marine and non-marine, with the Staten Island Clays referred to the latter division, the author considers no longer tenable. (Trans. N. Y. Acad. Sci. Vol. XI, 1892).

Mesozoic.—The validity of the Wallala beds as a division of the California cretaceous is questioned by Mr. H. W. Fairbanks. This division was made by Drs. White and Becker and comprises a series of shales, sandstones and conglomerates found in Mendocino Co., Cal. and Todos Santos Bay, Lower Cal. The Coraliochama, which White considers the characteristic fossil of the Wallala beds, is abundant in the Chico. Recent fossil finds show also that the fauna of Todos Santos Bay closely resembles the Chico. The general character of to the beds, together with resemblance of fauna, is sufficient evidence Mr. Fairbanks that the Wallala beds and the Chico are synchronous. (Am. Journ. of Sci., June, 1893.

Mr. T. W. Stanton's conclusions in regard to the California cretaceous are substantially the same as those of Mr. Diller. He finds no faunal break in the series of strata that have been referred to the Shasta and Chico formations. A comparison of the Shasta-Chico fauna with that of the Blackdown beds of England, shows that of 46 species figured by Sowerby from those beds, 23 are represented in the Shasta-Chico formations. The age of this fauna, therefore, is not more recent than the Cenomanian. (Bull. Geol. Soc. Am. June, 1893).

Cenozoic.—In discussing the affinities of a fish from the " terrain Bruxellien " described by Dr. Winkler as *Euchodus bleekeri*, M. Raymond Storms agrees with Mr. A. S. Woodward, that the fossil must be referred to Cybium, a genus represented in modern waters by at least a dozen species. (Bull. Soc. Belge de Geol. de Paleont. et d' Hydrol, T. VI, 1892).—At the June meeting of the London Zoological Society an account was given by Mr. Lydekker of a collection of bird bones from the Neocene deposits of St. Alban in the Department of Isère, France. The more perfect specimens were referred mostly to new species; *Strix sancti albani*, *Palaeortyx maxima*, *P. grivensis* and *Totanus majori*. Some of the specimens were indeterminable from their fragmentary condition. (Nature, June 15, 1893.)

BOTANY.

The Coming Botanical Meetings at Madison.—In connection with the meeting of the American Association for the Advancement of Science at Madison, Wisconsin, from August 17 to 23, inclusive, there will be much of interest to American botanists. The Society for the Promotion of Agricultural Science meets on the 15th and 16th. Beginning on Friday, the 18th, the Botanical Club will hold daily meetings. The new section of Botany (Section G) of the Association promises to be of unusual interest, inasmuch as the committee on programme has made a special effort to bring out some of the foremost botanists of the country, many of whom have consented to prepare papers. The announcement is made that there will be papers on Morphology, Physiology, Pathology, Systematic and Economic Botany, and special papers on "The Present Status of Botanical Instruction in the Colleges and Universities of this Country," and "The Present Aspect of the Nomenclature Question."

Following all these will come the International Botanical Congress, of which mention was made in the NATURALIST some months ago. The Committee having the matter in hand have issued a circular announcing the congress, as follows:

"An International Botanical Congress will be held at Madison, Wis., U. S. A., beginning August 23, 1893, and continuing three or more days. All botanists are eligible to membership, and are earnestly requested to attend the sessions, so far as possible. A membership fee of two dollars will be required.

"The purpose of the Congress is the presentation and discussion of botanical questions of general interest relating to the advancement of the science. It is expected that the International Standing Committee on Nomenclature, appointed last year at the Genoa Congress, will present its first report at this time. Papers embodying research will not be received, but such papers, whether by American or foreign botanists, may be presented before the Botanical Section or the Botanical Club of the American Association for the Advancement of Science, which holds its annual meeting preceding that of the Congress (August 17 to 24).

"Reduced rates of travel by steamship or railway cannot be provided by the Congress, but special rates can be obtained for the World's Columbian Exposition at Chicago. Madison is reached by several lines of railway from Chicago, and is distant only about four hours.

"It is hoped that societies will send delegates to the Congress. It is requested that all persons intending to be present notify the chairman of the committee of arrangements at as early a date as possible."

The committee, consisting of Messrs Arthur, Bailey, Britton, Campbell, Coulter, Coville, Galloway, MacMillan, Robinson and Underwood promises to issue a programme of the sessions before the meeting. In the meantime further information may be obtained of the chairman, Dr. J. C. Arthur, Lafayette, Ind.—CHARLES E. BESSEY.

Freshwater Algæ.—Dr. A. C. Stokes has rendered a good service to beginners in the study of the fresh water algæ by preparing his little book "Analytical Key to the Genera and Species of the Fresh Water Algæ and the Desmidieæ of the United States." It contains 117 pages of matter, and a plate illustrating the genera. As brought out by the publisher E. F. Bigelow of Portland, Conn., it is a neatly printed, cloth-bound volume, which he sells for the moderate price of $1.25. It merits an abundant sale. The following suggestions taken from the introduction may be useful to beginners:

"Algæ and Desmids are singly invisible to the naked eye. It is only when they occur in large masses that the eye can take cognizance of them. It rarely occurs, however, that the Desmids are so abundantly congregated that they thus obtrude themselves on the observer. When a large quantity has been collected and the vessel placed near a window, they will collect in a green film at the surface of the water on the lighted side, and there become visible in mass. In the ponds and shallows such an occurrence is not common. At times they are found so abundantly that by holding a glass vessel of the water up to the light they may be seen floating about as minute green objects, which the trained eye will recognize and the pocket lens make distinct. But these varieties are among the largest of the forms; according to my experience they are always exclusively confined to the Closteriums. Other large forms, like Micrasterias, at least in the writer's locality, rarely occur in such profusion. To collect the Desmids, therefore, it is necessary to collect by faith. The microscopist can know exactly what he has only when he gets home and examines the water, drop by drop, under the microscope.

"With the Algæ it is different. These are usually visible to the naked eye, as they are almost invariably collected in large masses, floating on the surface, submerged just beneath the surface, or attached in waving tufts or fringes to sticks and stones and other plants in the ponds. The eye of faith is not needed to recognize them. They usually force themselves on the wandering attention of the observing pedestrian in the wayside lanes, beside the ditches and slow brooks. As soft emerald clouds, or graceful streamers floating in the sluggish current, or resting like a green scum on the surface, they are readily seen and easily gathered. No collecting tools are demanded for either Algæ or Desmids, except a dipper of some kind, a common tin dipper is as good as anything, and a few bottles or other vessels to carry the treasures home, and to keep them concealed from inquisitive people; the collecting naturalist must always be prepared for meeting with such persons."

ZOOLOGY.

Zoology of the Lower Saskatchewan River.—Prof. C. C. Nutting's report on Zoological Explorations on the Lower Saskatchewan River is condensed statement of a large amount of information. The expedition was sent out by the Iowa State University, with the primary object of getting a series of birds in summer plumage, and also the downy young. Prof. Nutting, however, got all he could in all directions. Much of the interest of the report lies in the descriptions of the habits of the various animals, either as observed by the party themselves, or told them by the hunters of that region.

In speaking of the geography of the country explored, Mr. Nutting refers to the water system as comparable in extent to that of the Mississippi River. From the Saskatchewan River to the Polar Sea is one inextricable maze of lakes, rivers and marshes, one of the greatest palustral regions in the world, perhaps, and the breeding place of most of our migratory birds.

The region is one of unusual zoological interest, being to a certain extent characterized by an intermingling of eastern and western, arctic and temperate faunæ. The whole region is covered with dense forests of conifers and poplar. The formation is Upper Silurian, and the principal paleontological feature is *Pentamerus decussatus* of which a fine series was secured.

The birds collected, numbering 104 species, were the summer residents of that region, of which 90 per cent are birds included in the avifauna of Iowa.

In regard to the migration of birds, the view held by the writer is that the impulse to migrate comes *from without* and the act is a *conscious* seeking for a more suitable clime, on the part of the adults at least, the young simply following or imitating their elders. There is much to indicate that this stimulus comes in the form of *the wind.*

Only a fragmentary list of the mammals is given. One snake was found, also three frogs and five fishes; but a large number of insects and molluscs were secured. (Bull. Lab. Nat. Hist. Iowa State University Vol. II, No. 3, 1893).

Zoological News. General.—A correspondent of The Naturalist has communicated a curious fact to that Journal. Along the estuary of the Humber River an excavation has been made in a quarry into which the water of the estuary overflows but cannot return to the river. This water is brackish and contains a few sea fish, among which are some whitebait and herring. These fish thrive and reproduce themselves, but are reduced in size and are gradually forming a dwarfed species, especially the herring. These brackish water fish could easily be utilized for pisciculture. Mr. Yarrel reports that the whitebait adapts itself to fresh water where it grows and multiplies almost as well as in the sea, furnishing a table fish which for size and flavor is not surpassed by its salt water relatives. (Revue Scientifique June, 1893).

Invertebrata.—Dr. J. G. de Man has recently published in quarto form full descriptions of 129 species of Decapods found in the Indian Archipelago. Among them the author notes 27 new species and 9 new varieties. They are all classified under 50 genera. Fourteen plates, and a table showing the geographical distribution of the fresh water species accompany the paper. (Zool. Ergeb. einer Reise in Neiderl. Ost. Indien, Zweiter Bd., Leiden, 1892).

According to Dr. M. Weber 112 species of fresh-water crustaceans have been found in the Indian Archipelago, of which 83 are Decapoda, 10 Isopoda, 6 Ostracoda, 5 Cladocera, 4 Amphipoda, 2 Copepoda, 1 Branchiura and 1 Branchiopoda. (Zool. Ergeb. einer Reise in Niederl. Ost. Indien, Zweiter Bd. Leiden, 1892).

Vertebrata.—Mr. J. A. Allen reports 17 mammals and 162 birds collected in northeastern Sonora and northwestern Chihuahua, Mexico, on the Lumholtz Archeological Expedition 1890–92. Of the birds 12 species occur as resident birds within 150 miles of the southern border of the United States. (Am. Mus. Nat. Hist., March, 1893).

A summary of the species of Reptiles and Batrachians of Wisconsin published by Prof. W. K. Higley gives Lacertilia 4, Ophidia 22, Testudinata 13, Anura 8, and Urodela 12. Among the turtles is mentioned *Macrochelys lacertina*, the Loggerhead Snapper which the author says is occasionally found in the Mississippi River as far north as the mouth of the Wisconsin. (Wis. Acad. Sci. and Arts, Vol. VII).

EMBRYOLOGY.[1]

The Sea-urchin egg.—Hans Driesch[2] has recently made an interesting addition to his previous work upon the eggs of *Echinus mricrotuberculatus* and *Sphærechinus granularis* by the aid of an improvement in his methods.

He reaches the conclusion that by operative interference cells of the cleaving egg are made to form entodermal structures though they would normally have formed ectodermal structures.

In his larger paper[3] the author described the peculiar results obtained when eggs are subjected to pressure under a cover glass.

In such eggs the elastic membrane must be ruptured by pressure in order that it may not tend to restore the original spherical shape when the pressure is removed, but when the eggs are compressed sufficiently to break the membrane many of them are irreparably injured. Subsequently he found that if the eggs are shaken for 4 or 5 seconds in a glass the membrane may be removed from all of them without any injury to the eggs. This, however, must be done at the right time, about three minutes after the sperm has been added to the eggs and the membrane is just plainly separating itself from the egg.

These membraneless eggs are subjected to the pressure of the cover glass when they have divided into 4 cells. Under such circumstances they form a disk of 8 cells, since the cleavage spindles now lie horizontally or at right angles to their normal position.

When the pressure is removed the 8 cells divide at right angles to the plate, forming 16 cells in two layers of 8 each; however there are rarely 4 but usually only 2 micromeres formed and these 2 frequently lie out at one side of the double plate, not beneath the cells that formed them. From this double plate of 16 cells there is next formed a double plate of 32 cells. The important point here is that, as the author maintains, no rearrangement of cells takes place but merely a horizontal division of each of the 16 to increase the whole to a double plate of 32, 16 in each layer; yet the cells that gave off the peripherally placed micromeres do divide vertically and thus fill the gap in the lower plate, which would otherwise remain with only 12 cells. These 12 with, the 2 vertically formed ones and the 2 products of the 2 micromeres make up the 16 of the lower plate.

---

[1] Edited by Dr. E. A. Andrews, Baltimore, Md.

[2] Anatom. Anz., April 8th, 1893.

[3] See THE AMERICAN NATURALIST for February, 1893.

This double plate of 16 cells is the blastula stage, the author affirms, and becomes a complete larva without rearrangement of cells. It follows then that the normal animal pole of the egg is now found as a circular zone of cells about the equatorial periphery of the embryo while the vegetative pole of the normal egg is now represented by two isolated cells, one at each polar region of the entire mass; this is a disk that is becoming spheroidal by the conversion of the central parts which we have called its upper and lower surfaces into the peripheral zone or equator of the sphere.

If the eggs are kept under pressure till 16 cells are formed these are found to be in a single layer. When now this plate of 16 cells is set free and a second division in accomplished there results a double plate of 32 cells having 16 in each layer. This seems almost identical with the above described 32 cell stage and like it may form a complete normal pleuteus larva. As a matter of fact the two 32 cell embryos differ in the important item that cells having homologous positions in the two may have different relationships to the cells near them. Thus in the latter case cells at the periphery overlying one another, one in each layer, are brothers while like-placed cells in the former embryo are cousins. Another difference is that the 2 micromeres of the latter embryo do not divide into 4 equal cells but into 2 larger 2 smaller, as is the case in the normal embryo.

From the above facts, which are illustrated by camera drawings, the author concludes that so fundamental a displacement of cells has been brought about that, first, some ectoderm arises from what would have been entoderm and second, that entoderm arises from what would have been ectoderm. The first conclusion is evident from Selenka's observation that the entodermal invagination is normally opposite the animal pole, or region of micromeres. For if these experiments are credited, the vegetative part of the egg is displaced into two separate sets of cells; later but one digestive tract arises, hence some of these two sets of vegetative cells must have taken part in the formation of ectodermal structures.

If we may assume that the micromeres are a determining influence, or that the entoderm *must* arise opposite them, even in these abnormal specimens, then the entoderm will be formed from a part of the abnormal egg that is purely of the animal pole or normally to form but ectoderm.

Unfortunately the authôr has no observations upon these interesting stages of the abnormal larvæ and we have no real knowledge of what cells actually form the entoderm.

A Contribution to Insect Embryology.[4]—Under this title Mr. W. M. Wheeler presented to the Faculty of Clark University a dissertation that demonstrates the high ideals attained in Biological work at that institution.

It is sufficient indication of the character of the work to say that it is worthy of the elegant illustration it has found in the Journal of Morphology.

It is chiefly a study of gastrulation, formation of embryonic membranes, nervous system and reproductive organs in the locust, *Xiphidium ensiferum* Scud., though a much broader view is given by illustrations drawn from the author's work upon numerous other insects, notably the Orthoptera.

The eggs of this insect are laid in the willow galls produced by a Cecidomyia. They were hardened in water heated to 80° C. and afterwards kept in 70 per cent alcohol for weeks or months to allow the yolk to shrink from the chorion. Surface views and sections were then prepared by methods but little modified from those of Graber and of Patten.

The blastopore extends nearly the whole length of the germ band and is bifurcated posteriorly in a way strangely suggestive of the "sickel" of the chick embryo. It closes from each end toward the middle or future baso-abdominal region and by a process of "slurred" invagination thus gives rise to the mesentoderm.

In almost all other Orthoptera there is also, the author shows, an invaginate gastrula.

Later a most remarkable migration of the embryo takes place and complicates the difficult subject of the complex embryonic membranes.

Lying first upon the ventral surface of the egg, with its head toward the anterior and sharper end of the egg, the embryo actually sinks down into the yolk and by bending comes to lie upon the dorsal side with its ends reversed, its head toward the posterior or larger end of the egg. The appendages having meanwhile become so well developed that the leaping legs are distinguishable from the others, the embryo moves back into its original position upon the ventral side of the yolk, bending back so that it lies as at first. This second migration, however, is not through the yolk but upon its surface, over the posterior end of the egg.

These peculiar movements of the embryo, which the author would embrace under the term "blasto-kinesis," may, he thinks, be explained as of physiological use. He first shows that the primitive winged insects probably had eggs with considerable yolk and dense envelopes of chitin. The rapidly growing embryo, feeding upon the yolk must give off waste products that might accumulate in the adjacent yolk. Hence, it would be of advantage if the embryo could move away to yolk not contaminated.

---

[4] Journal of Morphology, Vol. VIII, No. 1, 1893.

From a comparative view of similar movements in Orthoptera the author infers that the more complete migration movements are primitive and that the more restricted movements have been more recently assumed; while in other groups various stages of disappearance of these blasto-kinetic phenomena have been described.

A classification of the insects based upon these movements and the character of the embryonic membranes would not, the author is convinced, conflict with that of Brauer, though the embryological evidence would tend to subdivide the Orthoptera or raise the value of the families of this group.

These embryonic membranes in Xiphidium are very numerous and complicate the above movements of the embryo, are, perhaps, the cause of the return movement. The serosa covering the entire yolk becomes cut off from the folds, amnion, covering the ventral face of the embryo so that the embryo first sinks into the yolk free from the serosa, which surrounds everything, but carrying with it the amnion. When the return trip begins, however, the amnion is again grown fast to a super-jacent membrane, the indusium, and is ruptured before the embryo can advance. This it does by becoming evaginated from the pouch of the amnion, out of which, also, an amniotic liquid escapes. The reflexed membranes do not form the dorsal surface of the future insect but are thrown off; in fact this is the case, the author thinks, in all insects: the envelopes may be variously absorbed or cast off in different cases, but in all they are to be regarded as specialized organs that have performed their part and are not used again in the formation of the body wall of the insect.

The indusium to which the amnion adheres is a most remarkable organ that first appears as a faint disk of cells anterior to the embryo when the blastopore is open.

Later this plate of cells is for awhile connected with the head lobes of the embryo, which then assumes a clover leaf outline, disappearing when the plate becomes again free.

This plate of cells is grown over by the serosa so that an amnion is formed over it just as over the embryo, the edges of the plate rising up to meet as a thin amnion beneath the serosa. This amnion is cut off from the serosa; it may be called the outer indusium to distinguish it from the thicker disk of cells, the inner or true indusium, lying upon the yolk. The indusium is then a double body lying anterior to the embryo and free. So it is not carried away when the embryo sinks into the yolk but remains and grows in all directions as a double layer between the serosa and the yolk. This double sac externally meets itself on the dorsal mid line of the egg and fuses with itself, inner indusium with inner, outer with outer. Thus the embryo becomes covered in by four cellular membranes; of these the inner indusium also secretes a granular substance and a cuticle.

As to the origin of these structures the author inclines to the mechanical conception regarding the amnion, since the insect may be regarded as sinking down from the surface in its formation much as in the case of some "invaginal disks," heads of cysticercus, the nemertean in the pilidium, etc. The indusium is, however, a structure found only in the Locustidæ, but may be homologized with a solid mass of cells, the so-called micropyle of certain Poduridæ. This micropyle in turn is comparable to the "dorsal organ" of crustaceans which possibly goes back to some sucking disk of some remote annelid-like ancestor.

The author's discoveries regarding the formation of the nervous system form one of the most interesting chapters of the present contribution and add to the evidence for the derivation of insects from annelid ancestors. The first recognized start of the nervous system is when the blastopore is still open and many large clear ectoderm cells are distinguishable in groups amongst the superficial common ectodermal cells. These large nerve-formative cells soon sink beneath the surface and are arranged in four long rows on each side of the blastopore. When that closes a median row is formed between the above four right, and four left rows. From these lateral and median rows of large cells the whole central nervous system is formed, at least all its true nervous substance. These cell rows do not, however, become directly converted into ganglion cells, but disappear, it is thought, after having budded off a mass of daughter cells. Each cell in one of the rows buds off successive cells that form vertical strings of cells; these strings form the thickness of the nerve cord and become the ganglion cells with their nerve processes. The continuous ganglionic mass so formed becomes divided into sixteen successive ganglia which are reduced by fusion to ten.

The brain is directly continuous with the ventral cord and, at least in the middle and posterior of the three regions into which it may be divided, differs from the ventral ganglia chiefly in the lack of the middle row of cells.

Contrary to what would be expected the optic nerve fibres seem to grow out from the brain toward the ommatidia of the eye.

While the author supports the view that the rows of nerve-cord forming cells in insects are homologous with the neural cell-rows of annelids (especially since they are most clearly shown in the oldest winged insects, the Orthoptera) he recognizes the possibility of this being merely a case of precocious segregation.

Another interesting part of the paper deals with the formation of the gonads and the sexual ducts.

The mesoderm is early split up into eighteen pairs of blocks, which become hollow and extend from the region of the definitive mouth to that of the definitive anus, the length of the blastopore. Two pairs correspond to the second and the third division of the brain, the others are in the thorax and abdomen. The first pair send out hollow diverticula into the antennæ; those back of the head send diverticula into the limbs.

In the walls of these hollow mesodermal sacs on the side next the median plane and the yolk, certain large cells become recognizable as the germ cells. These cells are formed, however, in the abdomen in the first to the sixth segments. They are of mesodermal origin, apparently, and first recognized when thus distributed in segmentally arranged clusters in the walls of the mesodermal sacs. In one abnormal case such germ cells occurred also in the tenth abdominal segment. These germ cells fall into the cavities of the mesodermal sacs and multiply by caryokinetic division. The six successive masses of germ cells become connected into one ovary or one testis by the outgrowths of solid diverticula from each sac to the one anterior to it and subsequent fusion.

The sexual ducts arise also from these mesodermal sacs. Thus, while in the head and thorax the diverticula that go to the limbs are converted into their muscles, the diverticula in the abdomen either disappear along with the transitory appendages or else remain as parts of the sexual ducts. In the male the mesodermal diverticula of the tenth abdominal segment remains as the terminal part of the sperm duct. The rest of the duct is formed from a solid ridge on the inner wall of the mesodermal sacs between the tenth segment and the anterior six forming the testis. The ducts then may be regarded as hollow outgrowths of the cœlomic sacs. In the female these diverticula are in the seventh segment, but at the same time there is a pair in the tenth. While the former become the oviducts, the latter, representing the terminal ampullæ of the sperm ducts, ultimately disappear. With the disappearance of most of the abdominal appendages there is still a retention of the posterior ones to form the ovipositor. The author makes out a clear case for the belief that this structure is formed from two or three pairs of real limbs.

The reproductive organs thus show resemblances to those of annelids, not only in the marked metameric character of the gonads, or clusters of cells on the cœlomic walls, but also in the fact that the ducts arise as cœlomic diverticula, since these diverticula may be homologized with nephridia by the aid of the condition of things probably existing in Peripatus.

ENTOMOLOGY.[1]

The Work of the Gypsy Moth Commission.[2]—For the last three years an experiment of great entomological interest has been in progress in the vicinity of Boston. About twenty-five years ago there lived in Medford, Mass., a man who experimented with silk worms of various kinds. Among other species which he had imported from Europe was that known as the Gypsy Moth—an insect that in Germany is very destructive to a great variety of trees and other plants. Some of these insects escaped and began developing in the neighborhood. They continued to multiply for many years until they became a plague to the community. The entomologist of the State Agricultural College was appealed to, and finally the Legislature appropriated $50,000 to be expended under the direction of a Commission appointed by the Governor, "to prevent the spreading and secure the extermination of the *Ocneria dispar* or Gypsy Moth in this Commonwealth." The Commissioners thus appointed remained in office about one year, when the work was turned over to a Committee of the State Board of Agriculture, consisting of Professor N. S. Shaler, Francis H. Appleton and Secretary Wm. R. Sessions. This committee soon called into consultation a number of prominent entomologists, and later appointed Professor C. H. Fernald entomological adviser. Mr. E. H. Forbush was elected director of field work.

Since the time of these appointments additional appropriations have been made and the work of extermination has been vigorously prosecuted. A large force of men has been kept at work fighting the insect in all its stages. The infested area has been accurately determined and every precaution has been taken to prevent its further spread. The results already obtained are very remarkable: where three years ago every green thing was alive with the worms, during a recent visit I had difficulty in finding any. The localities in which the insect is still present in numbers are comparatively few and are receiving so much attention from the director that a year hence they will be still fewer.

An idea of the general methods of work may be obtained from the following extract from the Director's first report: "It was at once seen that the work of crushing out the species would be an arduous task.

---

[1] Edited by Dr. C. M. Weed, New Hampshire College, Durham, N. H.

[2] Reports of the Mass. Board of Agriculture on the Extermination of *Ocneria dispar*, 1892 and 1893.

For an undertaking of this character and magnitude, men were needed who by nature and training were fitted for the work. A perfect system was imperative. An intimate acquaintance with the country must be acquired. An accurate knowledge of the habits of the insects was a necessity, and constant vigilance an indispensable requisite.

"When field operations were commenced, the eggs of the gypsy moth were the only living form of the pest. The men were carefully trained to recognize and destroy them, and to distinguish between their eggs and those of our native moths. They were taught to observe all evidences of the existence of the gypsy moth, and were requested to secure all information possible in regard to its habits. Each inspector was instructed to make out a daily written report of the work done by himself and his men, and to include in this report his observations on the habits of the insect. Many valuable facts were thus recorded during the season. As the force was organized, each inspector was given a squad of men, and a section, indicated by a map, was allotted him, with instructions to inspect it, and destroy the eggs therein. When eggs were found upon a tree, the tree was marked with white paint and the locality designated upon the map. Special implements for the work were invented as necessity required, and a stock of equipments and materials was gradually accumulated.

"At this time the gypsy moth was supposed to be confined to eight or nine towns. Inspectors were sent out to determine how far it had extended, and soon found small colonies in other towns. It was at once evident that inspection must be continued until the limits of the infested district was determined. This method was followed until the new leaves covering the trees rendered further inspection impracticable. The work was resumed when the caterpillars had nearly reached maturity, was continued after the leaves fell, and is still in progress.

"After the men had received the training and experience without which their work would have been of little value, there remained but six weeks in which to make a hasty inspection of the territory and destroy the eggs. Although the work was thus necessarily hurried and imperfect, yet, in consequence of it, the insects have not since appeared in more than sixty localities where the eggs were found in the spring. The infested towns farthest from the centre were first visited by the men engaged in destroying eggs. The men worked from these towns toward Malden and Medford. Before this work was completed the eggs began to hatch. This rendered thorough work an impossibility. No attempt was made, therefore, in the spring, to complete this work in Malden and Medford, except upon trees on or near the highways.

"Wherever worthless, hollow trees were found infested, they were felled and burned. More than one hundred acres of brush and woodland have been burned over, and everything upon it destroyed. Stone walls in which eggs were laid were thoroughly cleaned by fire. In this way vast numbers of moths and their eggs were destroyed during the season.

"As it was observed early in the campaign that the distribution of the caterpillars was effected largely by their falling from the trees upon teams, an effort was made to destroy all eggs upon trees on or near the highways. Before the hatching of the eggs, many of the large street trees in Malden, most of those in Medford and some in Somerville, were banded with strips of tarred paper. This work was first undertaken in Medford. It was proposed by the selectmen of that town as a means of protecting the street trees from the gypsy moth and the canker worm. It proved a very effective means of preventing the depredations of each of these species. The town furnished the labor and paper for banding the trees in Medford. These strips were kept moist by a regular application of a mixture that the caterpillars could not cross. Great numbers of eggs had been deposited on buildings, fences and other objects near the trees. As soon as the young caterpillars left the eggs, instinct led them to the trees, and, as they crawled upward to find food, many were entangled in the cotton waste under the tarred paper and perished. Many more succeeded in getting upon the paper, and, in cases where they were very numerous, would undoubtedly have bridged the mixture upon the paper with their bodies, until some had passed over. The men employed in applying the mixture from day to day prevented this by killing them with their brushes. Some eggs in the trees which had been missed in the spring doubtless hatched, but most of the caterpillars descended from the tree at one time or another, and were unable to return. This greatly reduced the danger that had seemed imminent in the spring,—that the caterpillars would be distributed in large numbers."

Various other methods of destruction are now being used, and valuable experiments with insecticides are being carried on, chiefly at Amherst in the insectary of the Hatch Experiment Station under the direction of Professor Fernald.

It seems to me after a careful inspection of the work in progress that it is being well done, and that its continuation is a matter of national importance. Should this insect become generally distributed it would be liable to cause enormous losses, and even if European parasites were introduced there would inevitably be fluctuations in numbers which would involve periodical outbreaks. I believe with Professor Fernald that the extermination of the pest is possible, "provided the work be continued for several years with sufficient appropriations to keep the entire territory under careful supervision."

Through the kindness of the Committee the NATURALIST is able to present the accompanying colored plate showing the various stages of the Gypsy Moth. The adult females are represented at Figs. 1 and 2; the adult males at 3 and 4; the pupa, (slightly magnified) at 5; the caterpillars at 6 and 7; the egg cluster at 8, and eggs magnified at 9 and 10.

Mr. Forbush has summarized the habits of this caterpillar as follows; "The gypsy moth feeds only when in the larva or caterpillar state. The length of larval life varies somewhat according to circumstances, but probably averages ten weeks. When the caterpillars are first hatched from the eggs they are light in color and covered with whitish hairs. In a few hours they assume a dark hue. They usually remain on or near the egg cluster until they change in color, and, should the weather be cold, they sometimes remain for several days in a semi-torpid condition upon the egg clusters. If the temperature is favorable they will search for food before they are twenty-four hours old. If a green leaf be dropped upon a table on which some of the caterpillars have been placed, they will all move towards it and climb upon it. During the first few weeks of their existence they remain most of the time on the leaves, feeding usually on the under side. Their feeding habits are so uncertain that no rule can be given which will apply to all individuals, but as a rule when about half grown they begin to manifest their gregarious instincts. At that time and for the rest of their existence as caterpillars they spend a large part of the day clustered in sheltered situations, and feed principally at night, going up the trees and out on the branches after dark, and returning before daybreak. Where they are so abundant that the food supply is insufficient, they evince much restlessness, and feed in numbers during all hours of the day and night. They may be seen hastening to and fro, both up and down the trees. Those which have fed sufficiently are at once replaced by hungry new-comers, and the destruction of the foliage goes on incessantly.

"At such times the trunks and lower branches of the trees are covered with a moving mass of caterpillars. Hurrying throngs are passing and repassing, and nearly every leaf or denuded stem bears up one or more of the feeding insects. The rustling caused by their movements and the continual dropping of excrements is plainly audible. On tall trees the larger caterpillars appear to crawl to the higher limbs, and they seem to prefer to feed well out toward the end of the branches. They do not feed gregariously except when in great numbers; therefore they seldom strip one branch, as do the larvæ of the *Vanessa antiopa*, but scatter throughout the trees, eating a little from each leaf. Early in the season, when they are small and few in number, their ravages are scarcely noticed; but as they grow larger and more numerous their inroads on the tree decrease the foliage area night by night, until suddenly the leaves appear to have been eaten in a single night, and the tree is stripped."—CLARENCE M. WEED.

ARCHEOLOGY AND ETHNOLOGY.

Eighth International Congress of Americanists, Paris, 1890.—M. De Quatrefages was President, and this was the last public function at which he assisted.

Dr. Brinton was one of the Vice Presidents and presided at one of the meetings. M. Desiré Pector, of Nicaragua, but resident at Paris, was Secretary General. There were four or five hundred adherents, about one-half of whom were in attendance.

The questions for discussion were prepared in advance by the committee and announced to the members by circular. One group was as to the

HISTORY AND GEOGRAPHY OF AMERICA.

The first question in that group was that presented in 1875 and discussed at nearly every Congress since; Whether the name "America," given to the Western Continent, was not taken from the chain of mountains of a similar name which form cordilleras between Lake Nicaragua and the Mosquito Coast, rather than from the discoverer, Americus Vespuccius? The affirmative was maintained by Prof. Jules Marcou and M. Lambert de St. Bris. The contrary opinion, to wit:–that the name of America was given at San Die near Nancy, and published by Waldseemüller under his *Cosmographia Introductio* was maintained by MM. Jimenez de la Espada, Dr. Hamy, Desiré Pector, Julio Calcano, and others. At the close of the discussion, the President remarked that after the conclusive communications which they had made in favor of the transmission of the name from Americus Vespucci, the question as to the derivation of the name was forever decided and settled. "And," said he, "I hope that it will never figure on the programme of our future Congresses." The question as to an earlier discovery of America was maintained by Mr. Lambert de St. Bris, who attempted to prove that there had been a voyage of Cabot earlier than that of Americus Vespuccius, and also the legend of one still earlier by Cortereal; but none of these met any favor from the Congress, and on the other hand, were universally denounced as traditions and unsupported by evidence.

Mrs. Shipley (née Brown) entered a paper on the "Missing Records of Scandinavian Discovery," declaring her belief in their existence and attributing their suppression to the authorities of the Roman Catholic Church.

The Scandinavian Discoveries of Greenland, was presented by M. Valdemir Schmidt, while M. E. Beaubois argued in favor of the migrations of the Gaul to America during the Middle Ages. MM. Paul Gaffarel and Charles Cariod presented a history of the Discoveries of the Portuguese in America in the time of Christopher Columbus.

Dr. A. Ernst presented some observations upon the culture of the Banana in America. J. Sylvario Jorrin questioned whether there was an authentic portrait of Christopher Columbus, and Dr. Francisco Henriquez y Carvajal argued that the remains or ashes of Christopher Columbus were not removed from San Domingo to Havana as was intended and believed. In support of this, he presented the inscription of one of the sarcophagi at San Domingo, indicating that it contained the remains of Columbus. This assertion gave rise to discussion in which this inscription was denounced by de la Rada y Delgado as false and bearing evidence of having been made in modern times. The "Ancient Cartography of America" was presented by Mr. Shipley, and M. Gabriel Marcel gave interesting account of the globes in the Bibliotheque Nationale on which the Continents of America were figured.

The next group of questions comprised

AMERICAN ANTHROPOLOGY.

Dr. Ten Kate supported the thesis of Dr. Virchow at the Seventh Congress, to wit:–that we must definitely renounce the theory of a universal type among the American Aborigines. Dr. Ten Kate declared in favor of a plurality of types in America. He found from Cape San Lucas to the River Gila, a distance of 600 kilometres, the extremes of cephalic forms, the indices varying from .6 to 10.0, although he gives no opinions as to which was the most ancient form. The height, too, varies from one metre and 57 centimetres to one metre and 87 centimetres. Taking into consideration these and all other dimensions, he thought he could distinguish more than one type which may have been primitive. He dissents from the idea of the American Indian being a red-skin, but says that his skin is brown or yellow, and to be accounted for by atmospheric and other influences. Dr. Ten Kate declared his conclusions based upon his experience after having made critical anthropological examinations of a large number of Indians, both individual and in tribes. He is forced to the conclusion that many of them possess distinctive mongolite type characters, yet, while there are certain tribes in the northwest like the Tinneh, are undoubtedly of an Asiatic origin as demonstrated by other than anthropological evidence. He does not at all pretend that this similarity of character springs from Asiatic origin of the North American or that he descends directly from the Mongol. The object is to show the difficulty of determining between hypothesis and fact.

A paper was presented from Mr. Thomas Wilson on the subject of the Paleolithic Age in America. Mr. Wilson presented some of the paleolithic implements found throughout the United States and compared them with Chelléen implements and others of the paleolithic period of Western Europe—called attention to the similarity between the two, and explained at length the radical differences between these and instruments belonging to the Neolithic Age, and announces his conclusion that we may assume the existence of a Paleolithic Period in the United States. He says in a note that, as a working hypothesis, this conclusion is expressed under all reserve and subject to future discoveries; that it is intended to stimulate investigators to seek in the sands and gravels of the Quatenary geological Epoch for paleolithic implements, and that despite their want of beauty, to gather and preserve them for the sake of science. No argument is made as to whether they come from glacial or preglacial regions, nor is any attempt made from them to determine the civilization or culture of the Paleolithic Period, nor to find the man who employed or made these instruments.

The Marquis de Nadaillac presented and read an extended review of the evidence on the subject of "The Earliest American." His origin he confesses to be entirely unknown, but he is of the opinion that he occupied the continent of America during the glacial if not during the pre-glacial period, and that he passed through two periods of cold. In saying this, however, he expressly disclaims any attempt to establish a parallel of the glacial periods of America and Europe. His paper was published at length in the *Revue of Scientific Questions* of Brussels in July, 1891, and is not to be found in the report of this Congress. M. l'Abbe La Petitot, in discussing the paper of the Marquis, bore testimony to the quantity of remains of extinct fossil animals belonging to the Glacial Period which were evidences of having been used by the prehistoric man in the manufacture of his implements. Dr. Fernand de Lisle presented an elaborate paper of 30 or 40 pages, on the subject of the artificial deformation of the skull among Indian tribes of the northwest of America. He took the position alleging it to be borne out by anthropometry, and the experience obtained thereby, that the cranial capacity of the flat-head Indian after having been subjected to this artificial deformation, was not reduced in volume; that some of them were found to be of extreme capacity of 1625 centimetres, and that, consequently, there would be no reduction of brain-power; also he said this deformation being artificial, was individual and not transmitted by heredity.

Dr. Hamy gave a description of the Cliff Dwellers of the Sierra Madre.

Dr. Leon and Mr. Pinart occupied the attention of the Congress with descriptions of Dental Deformations among the Pre-Columbian Tarasques and the Indians on the Isthmus of Panama. Dr. Leon remarks that these Indians do not possess wisdom-teeth, and he attempts to account for it by a supposed want of virility evidenced by their being without hair on any part of their body, and their beard rudimentary. He found that they also were without canine teeth—being replaced by small molars. Their skulls were deformed artificially. He cited an ancient work *The Relacion de Mechuacan* which stated that the Indians with the round head and of natural form, were not considered brave in battle. M. Pinart remarked that among the Indians of the Isthmus of Panama, the incisor teeth were filed to a point, giving them a saw-tooth appearance. Among the females, on their arrival at womanhood, the canine tooth on the upper left hand side was broken out as a sign that they were fit for marriage.

Dr. P. Ehrenreich described his various voyages among the Aborigines of Brazil in 1884–5 and 1887–9, and presented before the Congress a collection of photographs he had taken.

Dr. J. Vilanova described a fossil man found by M. Carles in the valley of the river de la Plata, associated with or near to a skeleton of a Megatherium in the Pampean formation, which corresponds in its characteristics with the European Lehm. Dr. Vilanova has studied the question of fossil man in times of high antiquity, as probably no other Spaniard and but few others in all the world have ever done.

Dr. J. Deniker, Librarian of Histoire Naturelle at Paris, was charged by his Government with a scientific mission to Cape Horn, which he visited in 1882–3. He gave to the Congress a resume of his investigations under the title of Fuegien Anthropology. He first mentions the difference in appearance between the inhabitants of Tierra del Fuego and the Archipelago of Magellan. He describes the type which is based upon his measurement of more than a hundred living Fuegians. He remarks their striking analogy with the prehistoric skulls found by Lund at Lagoa Santa in Brazil, and by Roth at

Pontimilo, Argentine Republic. His conclusions are:–first—the existence in South America of a race or a variety of the American Race, of small height, meso- or dolichocephalic, nose concave—often retroussé in the root—large below, with prominent eyebrows shaped like lozenges, large mouth, etc. Second:—This race occupied in times of high antiquity a large part of South America, principally that south of the Amazon. Third:—At the present time, this same race in a more or less pure state reduced to a few tribes dispersed a long ways from each other, meaning the Fuegians at the extreme south of the Continent and the Botocudos much farther north on the headwaters of the Amazon. Fourth:—They are found isolated in small tribes disseminated throughout Brazil, Bolivia, Peru and Chili. Fifth:—That this race presents a striking contrast to the Patagonian and with several others of the ancient tribes. Sixth:—That it is probable that most of the indigenous population of South America are the issues arising from a mixture of the three races—the Fuegians and Botocudos, who are short in height and with dolichocephalic index,—the Patagonians who are tall and brachycephalic, and the Araucans Carabs who are small and brachycephalic, and possibly others unknown.

The group of questions under the head of Archeology was about equally divided between the United States and Central America. Mr. S. B. Evans investigated the claims made on behalf of the North American Indian as builders of mounds and other works of antiquity in the United States and Mexico. His conclusion was that the Indians were not the builders of the mounds and earthworks. His paper is an arraignment of the Bureau of Ethnology for having announced this theory. The spirit of his paper may be gathered from the following quotation:—

" The United States Bureau of Ethnology in its capacity as a Governmental department has seen fit to lay the weight of its commanding influence to a theory that all the works of antiquity in the United States are to be referred to the Indians. * * * Everything contrary to the theory they maintain and foster, is characterized as romantic and visionary in comparison with the opinion announced with something like official authority, by the respectable gentlemen who have created a school which might be designated as the Fenimore Cooper School of American Archeology, for the reason that it claims for the Indian more than he would claim for himself. Disciples of this school have met with the experiences usual to those who attempt to adjust facts to pet opinions, and a notable instance is reported in the

Fifth Annual Report of the Bureau, where a distinguished observer, writing under the sanction of his chief, alludes to the manner of Black Hawk's burial, and brings that forth as a proof that Indians built mounds within the historic period."

Prince Poutjatine presented an interesting paper accompanied by specimen illustrations of imprints of textile fabrics on Russian prehistoric pottery, and he brought for comparison, a collection of stamps and imprints similar in decoration and manufacture on prehistoric pottery of the United States of America prepared by Mr. Wilson of Washington, from the United States National Museum. The specimen presented by Prince Poutjatine were the result of excavations made by himself on his own property at Bolgoje, in the Province of Novgorod, midway between Moscow and St. Petersburgh. The similarity between these two sets of specimens from nearly opposite sides of the globe was truly remarkable. Pottery with these imprints of textile fabrics have been found in other parts of Russia—the Provinces of Wladimir and Laroslaw—as is noted in the work of the late Count Ouvaraw in the "Age de pierre en Russia." Prince Poutjatine argued that these facts were evidences of communication between Russia and Siberia with America across the Straits of Bering. To this opinion, however, Mr. Wilson did not agree, because the pottery of the United States thus decorated was not found in that part of the United States approaching Bering Strait.

M. Marcel Daly read an Essay at the Chronologic Classification of Monuments of Prehistoric America, but he presented it as nothing more than a working hypothesis, recommended to investigators for the determination of the truth.

Other papers upon American Archeology were those on Frescos on the Ancient Palace of Mitla, by Dr. Ed. Seler; Archeological Studies in Salvador by Capt. Montessus de Ballore; and Petroglyphs on the Isthmus of Panama and Central America and the Antilles by M. Pinart. He concludes that the art of making petroglyphs was most highly developed in the Antilles especially in Porto Rico, but nevertheless in the Islands of Granada, Guadeloupe, St. Christopher and St. John. He attributes this higher art to that race of prehistoric people who preceded the conquering Caribs. In Cuba, the petroglyphs are rare, and they are not to be found in Jamaica. The ruins of Tialuanaco were explained by M. T. Ber, who presented a photograph of these ruins, which he alleged to be the first ever taken. Interesting among them were huge blocks of stone 20 and more feet long in process of being sawed. The quarry whence they came was well known, and as it was on the borders of the island, the belief was that the blocks were transported on the water by means of rafts.

ETHNOGRAPHY.

The only paper upon this subject relating to the North American Indian, was that by Capt. John G. Bourke, 7th Cavalry, U. S. A., upon the Sacred Hunt of the North American Indian. The author witnessed one while among the Zuñi Indians of New Mexico, which he describes in detail. The "Hunt" was for the purpose of procuring meat to feed the Sacred Eagles of which there were 13 specimens and which furnished the plumage for the various dances and ceremonies. His description included other tribes. He showed a boomerang used by the Zuñi and Moquis. The blade was 20 inches long with a handle 3 inches, the blade was 2½ inches wide, ½ inch thick, bent edgeways 3 inches.

M. Desiré Charnay presented a memoir on the Analogies between the North and Central American civilization and that of Asia. His comparisons were based upon his own experiences in the former countries, compared with those of the latter as described by various authors.

Dr. Seler, of Germany, described Uitzilopochtli the God of War.? He also described some of the arts of the Ancient Mexicans, principally of working stone and making plume ornaments. This subject was continued by a paper by Mrs. Z. Nuttal on Quetzal-apanecaioth or the ancient plume head-dress of the Aztecs. She also presented a feather hat, Mexican or Aztec, the making of which was one of the specialties of the ancient Aztecs. It was seen by Mrs. Nuttal in the Pitti Palace at Florence, and was recognized by her as either the work of an Aztec workman or a reproduction thereof made by a Spanish Artist.

Other papers within this group were Popular Melodies of the Guatemala Indians by M. Raymond Pilet; The Limit to Prehistoric Civilization upon the Isthmus of Panama by M. Pinart; a description of the Antiquities of the Island of Aruba by the same author. M. R. de Semalla described the characteristics of the few remaining Caribs on the Island of Guadeloupe; M. Marcel treated upon the Fuegians at the end of the XVII century as they were reported in some of the unpublished documents of the Bibliotheque Nationale.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The World's Congress Auxiliary of the World's Columbian Exposition of 1893.—PROVISIONAL PROGRAM.—A Congress of Zoologists will be held, according to previous announcements of this committee, under the auspices of the World's Congress Auxiliary at the Art Institute Building in Chicago, beginning August 28, and continuing until the program of addresses and papers accepted is exhausted.

The present stage of preparation for the sessions of this Congress is shown by the following provisional program, each person whose name is placed against a topic on this list having accepted an invitation to prepare a principal address upon it.

"The History and Evolution of American Zoology and the Status and Tendencies of Zoological Science in America." Dr. G. Brown Goode, Director U. S. National Museum, Washington, D. C.

"The Geographical Distribution of American Animals." Mr. J. A. Allen, Curator of Departments of Mammalogy and Ornithology, American Museum of Natural History, New York.

"The Effect of Glaciation and of the Glacial Period on the Present Fauna of America." Mr. Samuel H. Scudder, Cambridge, Mass.

"Preliminary Account of the Formicidæ of the North American Fauna." Professor C. Emery, University of Bologna, Bologna, Italy.

"Lacustrine Zoology: Methods and General Results of Its Investigation." Professor Dr. F. A. Forel, à la Faculté des Sciences de l'Université de Lausanne, Morges, Switzerland.

"The Plankton of the Muskoko Lakes, Ontario." Professor R. Ramsay Wright, Professor of Biology, University of Toronto, Canada.

"The Origin of the Subterranean Animals of America." Professor A. S. Packard, Professor of Zoology and Geology, Brown University, Providence, R. I.

"The History and Special Features of the Economic Entomology of the United States." Professor J. H. Comstock, Professor of Entomology and General Invertebrate Zoology, Cornell University, Ithaca, N. Y.

"The Special Problems of American Economic Entomology." Dr. C. V. Riley, Chief of the Division of Entomology, U. S. Department of Agriculture, Washington, D. C.

"Undergraduate Courses and Post-graduate Methods in Zoology," Professor E. L. Mark, Hersey Professor of Anatomy, Harvard University, Cambridge, Mass.

"The Zoological Museum." Mr. F. W. True, Curator of Mammals, U. S. National Museum, Washington, D. C.

"Kinetogenesis, or the Relation of Motion to Organic Evolution." Professor E. D. Cope, Professor of Mineralogy and Geology, University of Pennsylvania, Philadelphia, and Editor of the AMERICAN NATURALIST.

"Energy in Relation to Organic Evolution." Professor J. A. Ryder, Professor of Comparative Embryology, University of Pennsylvania, Philadelphia.

"Principles of Bioplastology." Professor Alpheus Hyatt, Curator of the Boston Society of Natural History, Boston, Mass.

"The Cellular Basis of Heredity." Professor E. B. Wilson, Department of Biology, Columbia University, New York City.

"Continuity of Organization the Basis of Heredity, or the Organism and the Cell." Professor C. O. Whitman, Head Professor of Biology, University of Chicago, and Editor of the Department of Microscopy in the AMERICAN NATURALIST.

"Zoological Psychology and the Development of Mind." Professor C. Lloyd Morgan, Professor of Animal Biology in University College, Bristol, England.

"On Zoological Nomenclature." . . . Dr. Charles Girard, Paris, France.

"Zoological Nomenclature as a Means to an End." Dr. Elliott Coues, Washington, D. C.

The committee will be pleased to receive additional titles for this program from members of the Advisory Council of the Congress, or on their recommendation.

Suitable opportunity will be given after the reading of each address for its formal discussion. The committee have respectfully to request that all who intend to take part in the discussion of one or more of the above topics will indicate this fact in advance, at as early a day as may be practicable, to the chairman of this committee.

We have also to request that advance notice of an intention to attend the sessions of the Congress may be given so far as practicable.

S. A. FORBES,
Chairman Committee of Arrangements.

University of Illinois,
Champaign, July 20, 1893.

SCIENTIFIC NEWS.

The large scientific library of the late Prof. J. S. Newberry has been offered as a gift to Columbia College, New York. The collection will be known as the Newberry Library of Geology, being a memorial to Professor Newberry.

A Chair of Geography has been established at the German University of Tübingen. Geography is now taught at nineteen of the twenty-one German Universities, Rostock and Heidelberg being the exceptions.

Mr. R. Bowdler Sharpe is about to publish a Monograph of the Birds of Paradise and the Bower-Birds. This Monograph will be published in six parts, forming one volume imperial folio, uniform with Mr. Gould's Works, price three guineas each part, to subscribers only. On the conclusion of the work, should any copies remain unsubscribed for, the price will be raised to twenty guineas.

International Congress of Zoology.—The permanent Committee which has just been appointed for the International Congress of Zoology is as follows:—

President, M. Milne Edwards (Paris).
Vice-Presidents, M. Jentink (Leiden),
Count Kapinst (Moscow),
M. W. Studer (Berne),
M. L. Vaillant (Paris).
General Secretary, M. R. Blanchard (Paris).
Secretary, Baron J. de Guerne (Paris).

The permanent Committee propose the following question for the prize of S. A. I. le Tsarévitch, which will be awarded in 1895, at the Congress of Leiden.

A Study of the fauna of one of the great regions of the globe, and the relations of that fauna to the neighboring ones.

The judges will accept works bearing upon either a branch or a class of the Animal Kingdom.

The papers, manuscript or printed since the last Congress, must be written in French and sent before May 1st, 1895, to M. le President du Comité Société Zoologique de France, rue des Grands-Augustins, 7, Paris.

The papers presented will be examined by the following Committee: M. Milne-Edwards (Paris), President, R. Blanchard (Paris), General Secretary, A. Bogdanow (Moscow), Jentink (Leiden), R. B. Sharpe (London), W. Studer (Berne), and V. Zograf (Moscow).

We will publish later an official text of rules in regard to the prizes distributed by the International Congress of Zoology.

The prize given by the Imperial Society of the friends of the Natural Sciences of Moscow, in memory of the International Congress of 1892, *and in honor of Emperor Alexander III.*

RULES.

Article 1.—The Committee on Organization of the International Congress of Anthropology and prehistoric Anthropology, and of Zoology, in session in Moscow in 1892, place at the disposal of the Imperial Society of the friends of Natural Science the sum of 3,500 gold roubles to constitute a perpetual capital in memory of the two International Congresses and of the august kindness which has been accorded them by the Emperor Alexander III.

Article 2.—The interest of this capital shall be used as a prize in honor of his majesty, Emperor Alexander III. This prize shall belong alternately to the Congress of Anthropology and prehistoric Archeology and to the Congress of Zoology.

Article 3.—The value of the prize shall be equal to the interest on the capital for two years. In case there should elapse more than two years between two consecutive Congresses, the interest for the extra years shall be at the disposal of the Society of the friends of Natural Science of Moscow, which will devote it to the prizes distributed at the annual meeting of October 15.

Article 4.—If one of the two Congresses should cease to exist, the portion belonging to it in accordance with the above articles shall revert to the Imperial Society of the friends of Natural Sciences to be distributed by it equally among the prizes given at its annual meeting.

Article 5.—The prize given by the Congress of Anthropology and prehistoric Archeology is awarded by a special Commission nominated for that purpose by the permanent Council of that Congress. The prize given by the Congress of Zoology is awarded in the same way by a special Commission nominated for that purpose by the permanent Council of that Congress.

Article 6.—The prizes may consist of medals or of sums of money.

Article 7.—They shall be distributed at a special meeting while Congress is in session.

Article 8.—The program of the prizes shall be arranged by the permanent Council of each of the two Congresses.

Article 9.—It shall also be the duty of this permanent Council to the the papers presented, to appoint the Professors or the examining Committee to whom the papers will be submitted, and who must return a written report.

Article 10.—Any scientist may compete for the prize, on the condition that he does not belong to the country in which the next session of the Congress takes place.

Article 11.—The President of the Congress must notify the President of the Imperial Society of the friends of Natural Science of the name of the person to whom the prize has been awarded.

Prizes given by the Imperial Society of the friends of Natural Science of Moscow, in memory of the International Congress of 1892, *and in honor of S. A. I. the Grand-Duc Nicholas Alexandrovitch.*

Article 1—The Committee on Organization of the International Congress of Anthropology and prehistoric Archeology, and of Zoology, in session at Moscow in 1892, place at the disposal of the Imperial Society of the friends of Natural Science the sum of 2,000 gold roubles to constitute a perpetual capital in memory of the Congress of Zoology, and of the august kindness which has been accorded to them by the Grand-Duc Nicholas Alexandrovitch.

Article 2.—The interest on this capital shall be used for a prize in honor of the Grand-Duc Nicholas Alexandrovitch. This prize shall belong to the Congress of Zoology.

Article 3.—The value of the prize shall be equal to the interest on the capital for two years. In case there should elapse more than two years between two consecutive Congresses, the interest for the extra years shall be at the disposal of the Society of the friends of Natural Science, which will devote it to the prizes distributed by them during the annual meeting on October 15.

Article 4.—If the Congress should cease to exist, the portion belonging to it in accordance with the above articles shall revert to the Imperrial Society of the friends of Natural Science, to be distributed by it equally among the prizes given at its annual meeting.

Article 5.—The prize given by the Congress of Zoology is awarded by a special Committee nominated for that purpose by the permanent Council of that Congress.

Article 6.—The prize may consist of medals or of sums of money.

Article 7.—They shall be distributed at a special meeting while Congress is in session.

Article 8.—The program of the prizes shall be arranged by the permanent Council of the Congress.

Article 9.—It shall also be the duty of this permanent Council to the papers presented, to appoint the Professors or the examining Committee to whom the papers will be submitted, and who must return a written report.

Article 10.—Any scientist may compete for the prize, on the condition that he does not belong to the country in which the next session of Congress takes place.[1]

Article 11.—The President of the Congress must at once notify the President of the Imperial Society of the friends of Natural Science of the name of the person to whom the prize has been awarded.

ERRATA.—In Prof. Scott's paper on, A New Musteline from the John Day River, make the following corrections: Page 658, l. 21, read *Bunœlurus* for "*Buncelunus;*" l. 33 and p. 659, ll. 4 and 6 *Parictis* for "*Parietis;*" p. 658, l. 37, *P. primævus* for "*P princeous;*" p. 659, l. 2, *Quercytherium* for "*Inercytherium.*"

---

[1] The next Congress will be held in Leiden, August, 1895; the scientists of Holland are therefore excluded from the next competition.

Special Notice from the Publishers.—Owing to the absence of the Editor the publication of this issue was delayed. We shall always aim to get out each issue promptly on the first of each month, but our editors and authors being so wide-spread we are often delayed a few days in the return of the proofs of articles sent them for revision. With this explanation

we are, truly yours,
BINDER & KELLY.

RECEIVED
OCT 14 1893

THE

AMERICAN NATURALIST

VOL. XXVII. September, 1893. 321

THE PHILOSOPHY OF FLOWER SEASONS.[1]

BY HENRY L. CLARKE.[2]

The researches of recent botany have more than once suggested the vague outlines of a truth that, though manifestly requiring investigation, has as yet received but little definite expression. It is:—the philosophy that underlies the association of certain groups and types of flowering plants with certain definite seasons of the year; the principles that will show how this association accords with the "eternal fitness of things."

The subject is of broadly interesting scope, but its treatment requires caution because of the variety of somewhat conflicting considerations involved. Obviously the aim cannot be to find any single absolute principle that will cover all cases, but rather to make some broad general observations that shall embrace all the diverse circumstances and at the same time express each with greatest definiteness. The field for investigation must be clearly presented and have its data determinable with certainty and completeness, and such can be found in the flora of the northern U. S., eastward from the Rockies. This has been more thoroughly studied than any other so large section of American flora, and is familiar to a large proportion of students.

---

[1] Condensed for THE AMERICAN NATURALIST from a more extended thesis on the subject.

[2] University of Chicago.

Taking this, then, as the field, here is the problem presenting itself:—From March to November each month brings a new prospect in field and forest, an edition of flower-life distinctively its own; and each edition seems thoroughly to harmonize with its own peculiar season. Each offers characteristic features, and every careful observer can feel in this succession of differing forms a harmony into which any decided change would break discordantly. To bring this more forcibly to the mind, conceive for a moment the existing series somewhat transposed: imagine the prairies brilliant with Solidago and dotted with the purple Aster in early May; Trillium adorning the woodlands in September; the vivid Lilium superbum and the flaming Asclepias tuberosa in the April meadows; Hepatica and Sanguinaria in mid-July; and Epigæa in late autumn. Entirely aside from the element of novelty, such a picture would be bewilderingly inharmonious, and its features out of tune with their position by virtue simply of their character,—in this there would be an appreciable and evident lack of fitness. To say that the fall flowers are not the spring flowers, or those of summer are neither, merely because they have chosen at random this season or that is neither science nor common sense. The truth is forced upon us that the various groups of flowering plants are not scattered indiscriminately from one end of the seasons to the other, but are regulated by definite systematic principles; and that just as relations can be traced between physical geography and geographical distribution, or between plant-history and geological periods, so is there a connection between the relations of season to season and the relations of their respective floras.

In this inquiry we see constantly the impossibility of drawing sharp lines of demarkation between successive groups of conditions; and, as in classification systems, so in serially arranging successive floras, it is impossible to follow a linear order. Also, exceptional instances are many, and hence, to reach conclusions that are broadly true, *predominant* types must be considered, though the unusual cases may be in themselves manifestly significant. Only a broad sweep of data can bring out a general connection between the multiplicity of considerations. To this end it will be reasonable to consider the groups of flowering plants in the most strictly natural order of their evolutionary relationships, from the lowest up. That this evolutionary system is largely based on floral structure is suggestively apropos of our theme, but how far the intimacy of the connection may extend the further development of the discussion will reveal.

Passing to the outline of recorded observation we may discuss each condition of the problem as it arises. The three seasons considered have these limits;—spring; late March, April, May: summer; June, July, August: autumn; September and October. *All* statements *refer only* to the area about covered by Gray's Revised Manual: the U. S. north of Tennessee and eastward from west Kansas.

Of the two series of flowering plants, the Gymnospermæ and Angiospermæ modern botany concedes that the former, from their near approach to the higher Pteridopyta, represent the lower character of development, though the highly specialized Coniferæ may rise to a position nearly *parallel* to the highest Angiospermæ. The Coniferæ comprise all our indigenous Gymnospermæ;—and all flower in the spring from late March to earliest May, none in summer or autumn.

In the Angiospermæ, the Monocotyledons and Dicotyledons are two nearly parallel classes, the Monocotyls, though not transitional, representing, as a class, a lower character of development than the Dicotyls. Compare first the two classes in a general manner: The indigenous Dicotyls number much over twice the indigenous Monocotyls, and of the latter over half are in the great orders Cyperaceæ and Graminaceæ. And these orders demand special attention, for they together represent one of the most remarkable instances of high specialization in the whole census of plant-life. Apropos of this let us call to mind for further use the five characters of organic development which certain carefully systematic evolutiontsts!! have recognized:—*typical* forms, which present all the main characters of their group with fullest intensity; *generalized-normal* which have the normal characters somewhat poorly developed and defined; *specialized-normal,* which retain the normal structure but with evident one-sided development of it; *generalized-aberrant*, which depart from the normal but drift toward several or many outside relationships; and *specialized-aberrant*, which go off on a distinct individual line of their own. The Cyperaeæ and Graminaceæ are *specialized-aberrant* Monocotyls; and as they depart from the rest of the Monocotyls in structure, so, in the main, does their blooming season stand apart. Though extending from May, it culminates, particularly with the Graminaceæ, in the late summer and early fall, and stretches on into October. With reference to all other Monocotyls, note that by far the majority,—typical, normal, and *generalized-aberrant*,—confine their blooming season to spring, or early summer, or mid-summer, though fewer in the last. But in late summer and autumn occur only a few isolated cases. Indeed, even in the Glumaceæ excepted in the last statements, the great predominant genus of Cyperaceæ, the genus Carex, including much over half the order, belongs strictly to May. On the other hand, the Dicotyls, the higher Angiospermæ, are spread straight through the seasons, from March to November, represented by forms of all characters,—typical, normal, and aberrant. Thus, excluding Graminaceæ and several genera of Cyperaceæ, the Dicotyls may be said to constitute almost the entire flora of late summer and of autumn.

The Spadicifloræ and Liliifloræ form two fairly distinct subclasses of Monocotyls, closely parallel and somewhat interrelated. Though a debatable question, the imperfect and reduced flowers so general in the Spadicifloræ rather justify the conclusion that these are of the lower order of development. Moreover, throughout this subclass diclinism predominates, while the Liliifloræ are generally both hermaphrodite and complete and with well-developed perianth.

Normal and typical Spadicifloræ are the Araceæ. All these flower in May or June, except Symplocarpus. That its odorous scapes push out of the swamp mud in April is presumably a provision to insure cross-fertilization of the inconspicuous, though strong-scented, spadices before they are hidden by the subsequent growth of the huge rank foliage. Later, through the summer, flower the Typhaceæ, which, as *generalized-aberrant* Spadicifloræ, represent a rather more advanced degree of specialization than most Araceæ. Also in mid-summer come the remarkable little Lemnaceæ, usually considered a highly *specialized-aberrant* offshoot from Araceæ, though the connection is doubtful.

Among Liliifloræ the three apocarpal orders, Alismaceæ, Juncaginaceæ, and Naiadaceæ, form a remarkably aberrant group, of few species, but wide-spread, particularly Sagittaria and Alisma. All come in late summer, and some among the exceptional non-glumaceous Monocotyls of autumn. Potamogeton, in Naiadaceæ, numbers a good many species, and comes late; but note that the genus is one of the most peculiarly specialized.

All the Spadicifloræ and Apocarpal Liliifloræ are scarce a tenth of the remaining Monocotyls, the Syncarpal Liliifloræ. This division naturally subdivides into the Hypogynæ and Epigynæ, somewhat parallel and closely inter-related. In the light of our present knowledge of the morphology of the hypogynous and epigynous flower there can be no doubt that the Epigynæ here represent the higher order of development, although many Hypogynæ may rise to a more than equivalent degree of specialization,—precisely as the genus Felis is considered to represent a lower order of development but a higher degree of specialization than the anthropoid apes.

In the non-glumaceous Hypogynæ most prominent is the order Liliaceæ, in which are, pre-eminently, typical and normal forms. Among the normal, particularly the more generalized, the first bloom in late April,—notably, for instance, Erythronium, about the earliest of Monocotyls. Scarcely later come Trillium, Uvularia, Smilacina, Polygonatum, Maianthemum, and others. Other genera extend through May and early June, and a few, finally, belong to mid-summer. Certain of these last, as Allium and Smilax, are, though normal, markedly more specialized than the principal spring-flowering genera. But the mid-summer genus Lilium claims peculiar prominence as an ideally "*typical*" genus in all the term implies. *Lilium philadelphicum*, *L. catesbæi*, *L. canadense*, and *L. superbum* stand together in the July meadows as the type of their order and of the Hypogynæ. Their high order of development and their blooming season has a significant bearing on our problem. The aquatic Pontederiaceæ and the ephemeral Commelinaceæ, both few in species, and the odd genera Aletris and Xyris, are of mid-summer. With Smilax comes the nearly-related Dioscorea. Markedly conspicuous mid-summer Hypogynæ, rather intermediate between Liliaceæ and Cyperaceæ, are the widespread and aberrant, glumaceous types, Juncaceæ. But even these are less highly specialized than the two great orders Cyperaceæ and Graminaceæ, comprising over half of all our Monocotyls. The Graminaceæ are unquestionably the more highly specialized, and as distinctly *aberrant*, among Liliifloræ, as are the Lilia *typical*. Their period of greatest predominance extends from mid-July well into October. In Cyperaceæ it is curious that over half the order, the great genus Carex, attains full perfection in May; while the *type*-genus Cyperus belongs to August and September, most other genera to mid-summer, and a few to June. But mark especially: all the summer and fall Cyperaceæ, save a very few, are hermaphrodite, while Carex is entirely unisexual. The significance of this will come up later.

The review of Monocotyls closes with the Epigynous Liliifloræ, a small group compared with the Hypogynæ, but peculiarly interesting. Of the *generalized-normal* order Amaryllidaceæ we have only one wide-spread species, the little Hypoxis, of early summer. Iris comes in the spring and Sisyrinchium a little later, both rather specialized genera. Finally, the crowning glory of its class is the highly specialized order Orchidaceæ. Late in May come the earliest forms,—Orchis, Arethusa, and Corallorhiza. In early June:—Pogonia, Liparis, Calopogon, Listera, several green Habenarias, and the splendid genus Cypripedium. The succession of species in this genus is instructive:—Earliest, in late May, comes the little white *C. candidum;* a little later the low stemless type with its large complicated flower, *C. acaule;* still later the small-flowered but tall-growing *C. parviflorum;* later yet, the large cousin of the last, *C. pubescens;* and latest, late in June, most robust, vigorous, and conspicuous, the splendid *C. spectabile.* In late June and through July come other Pogonias and Corallorhizas; Microstylis, Goodyera, and one or two Spiranthes, and all the most beautiful Habenarias. Last, in September and October, singularly isolated from nearly all their kinsman, are several of the little Spiranthes,—why they come thus is a baffling question. Retrospectively we remark that of non-glumaceous Liliifloræ the two predominant orders are Liliaceæ and Orchidaceæ; that the first are largely normal and generalized, the second aberrant and specialized; and that the first predominate in the spring, the second in summer.

In the Dicotyls two quite distinct subclasses may be recognized: the one, the Diclinæ, is a very natural group, small but of great importance, embracing the closely related orders of trees and shrubs, Platanaceæ, Juglandaceæ, Cupuliferæ, and Salicaceæ; the other, vastly the larger, exhibits a broad, rather indefinite range of characters, and may be termed, in contra-distinction, the "Hermaphroditæ," because hermaphroditism, though by no means universal, predominates in it. The Diclinæ obviously approach the Coniferæ, among Gymnospermæ, in wood-structure and manner of growth, and in amentaceous diclinous inflorescence. Whence there is just reason to consider them, though wonderfully specialized, of a lower character of development than the Hermaphroditæ. Unisexual flowers, or the analogues of unisexual flowers, are the rule in Gymnospermæ and the higher Pteridophyta, and hence it reasonably follows that diclinous Angiospermæ are lower than hermaphrodite; and, further, diclinism in all Angiospermæ is either a perpetuation of the ancestral type or a reversion to it. In Diclinæ and in the Spadicifloral Monocotyls it is probably a perpetuation; in Carex, many Graminaceæ, and elsewhere among Angiospermæ, more likely reversion, retrogressive evolution. Note here the peculiar fact that in spring, from early March to June, blossom these diclinous groups:—all Coniferæ, the Araceæ, the great genus Carex, the Diclinæ, the Lauraceæ, several diclinous Ranunculaceæ, Urticaceæ, and many others; while in summer and fall come only:—a few Alismaceæ and Typhaceæ, many Graminaceæ, the Euphorbiaceæ, some Urticaceæ, and a few other isolated cases, but altogether a comparatively small number,—especially so because the Graminaceæ mentioned rarely have spikes entirely of unisexual flowers and hence do not strictly fit the case. The diclinism occurring in many Compositæ is not referred to, because it is not analogous to diclinism in other plants, and the Compositæ are relegated to a category of their own by their highly specialized inflorescence;—their diclinous "capitum" is functionally equivalent to a single perfect flower in other Angiosperms. The blossoming of so many trees, especially the Diclinæ, in earliest spring, before leaf-budding, must evidently have at least partial connection with anemophilous cross-fertilization.

The Hermaphroditæ (this term only signifying a *predominant* character) parts naturally into the Choripetalæ and Sympetalæ, nearly parallel and somewhat inter-related. The first includes the Incompletæ (so-called Apetalæ), which cannot be naturally made a separate division. It is conceded now that the Sympetalæ are higher than the Choripetalæ, though the divisions are not successive, save in that the first probably rose from some aberrant form of the second. There are three clear sub-divisions of the Choripetalæ, partly serial and partly parallel,—Hypogynæ (including so-called Discifloræ), Perigynæ, and Epigynæ. The Epigynæ are past question the highest, and the Perigynæ rather intermediate.

Earliest of the Hypogynæ are the Ranunculaceæ, peculiarly normal and typical and distinctively spring-flowering, extending from mid-April to early June. Hepatica, Anemonella, Caltha, Ranunculus, Aquilegia,—all synonymous with spring. Note that the more specialized forms, such as Aquilegia, Delphinium, Aconitum, etc., are the later, and some Clematis belongs to summer. With this early order come also our Magnoliaceæ and Berberidaceæ; late in May the Dicentra and Corydalis; through May and June the particularly natural and normal order Cruciferæ, more specialized, however, than Ranunculaceæ. In April comes that wonderfully symmetrical and typical form of the Papaveraceæ, the Sanguinaria. Remarkably aberrant in habit, but rather generalized in floral structure is the Sarracenia. It blossoms in latest May and early June. Among the earliest blossoms is the so abundant little normal type, Claytonia. Viola is a large, distinctive, and cosmopolitan genus, rather specialized-normal in character. Oddly enough it has species in bloom from April to October, some blossoming both spring and fall, besides producing cleistogamous flowers all summer. Yet even in so constantly present blossoms we easily recognize a period during which they reach by far their greatest abundance and perfection, viz.: May and June. Two unique orders belong to summer, Cistaceæ and Hypericaceæ, the second the later and remarkable particularly for its polyadelphous stamens. The incomplete flowered Urticaceæ belong mainly to summer, all save the group of spring-flowering shrubs and trees, Morus, Celtis, Planera, and Ulmus. All these are diclinous or polygamous, and Ulmus seems to possibly and probably connect its order with the Diclinæ,—like these it flowers in March and early April. Turning back to the near relatives of the Ranunculaceæ we find in mid-summer the aquatic genera Cabomba, Brasenia, Nymphæa, Nuphar, and Nelumbo, all *specialized-normal*, practicularly Nelumbo, the latest to flower. The so-called Discifloral Hypogynæ rank somewhat above such typical forms as the Ranunculaceæ and Cruciferæ, and among them stand several important summer orders:—Caryophyllaceæ; Malvaceæ; the strange Euphorbiaceæ of July, August, and September; and the Geraniaceæ, of which the aberrant Impatiens is latest. Anacardiaceæ belong to June. But the two tree-families, Tiliaceæ and Sapindaceæ come in spring and early June.

In the Perigynæ the preëminently normal and typical order is Rosaceæ, standing here as the Ranunculaceæ among Hypogynæ. Somewhat later than the latter order in starting the Rosaceæ reach perfection in late May and through June. At much the same time, but scattered along later into the summer, comes the less normal order Saxifragaceæ, of which the aberrant genus Parnassia, an odd little type, holds an isolated place in the late autumn flora. The distinctive order Leguminosæ, by far the most numerous of our Choripetalæ, flourishes throughout the summer and well into autumn. The aberrant Drosera is summer-flowering. Rhamnaceæ, and, particularly, the diclinous Lauraceæ, and the Hamamelidaceæ, belong to spring,—though Hamamelis, oddly enough, blooms in October.

As the typical Hypogynæ are characteristic of spring, so the several more important orders of Epigynæ belong peculiarly to summer and early fall:—the great order Onagraceæ, and the Lythraceæ; in late summer the strangely organized Passiflora; in hottest July our Cactaceæ, pushed up from the southwest; and in fullest sovereignty in July and August, though stretching from May to October, the widespread Umbelliferæ; the peculiar tropical Cucurbitaceæ from July to October; the more generalized Araliaceæ mainly in spring; and the shrubs and trees of the Cornaceæ also early. The anomalous Asarum and Aristolochia are scattered from May to July.

The Sympetalæ part naturally into the Hypogynæ, isocarpal and anisocarpal; and the Epigynæ. In Hypogynæ typical Isocarpæ, the more generalized group, are Ericaceæ, coming from earliest spring late into May and early June, and, at the same time, the Diapensiaceæ and Primulaceæ, the last rather later. Pyroleæ, in which there is a reversion to charipetalism, extend into July. Polemoniaceæ, somewhat transitional to the Anisocarpæ, bloom through May, June and July. In Anisocarpæ note:—the tree-order Oleaceæ, early flowering; the parasitic Orobanchaceæ, scattered from April to October; Catalpa and Bignonia in spring, and the brilliant *Tecoma radicans* in July; the Borraginaceæ, few in spring, reach perfection in summer; Convolvulaceæ and the unique Solanaceæ, from mid-summer into autumn; the aquatic Utriculariaceæ, entirely in summer; the great specialized orders Scrophulariaceæ and Labiatæ, throughout the seasons but in greatest predominance from mid-summer late into autumn; also then the Verbenaceæ. Apocynaceæ and the highly *specialized-aberrant* Asclepiadaceæ come in mid-summer. Characteristic of autumn are the Gentianaceæ, whose relation to the two last named orders gives them a high rank. A few species occur much earlier than the typical genus Gentiana.

Turn to the Epigynæ:—Caprifoliaceæ and Rubiaceæ, though scattered, predominate in summer; Campanulaceæ, particularly in late summer and in autumn,—the finest type *C. americana*, coming in September. Late in summer and in September, the Lobeliaceæ are in fullest perfection,—the splendid *Lobelia cardinalis* and *L. syphilitica* being late. And lastly, we meet the vast order Compositæ, undoubtedly nearly the highest of flowering plants. So numerous a group would naturally spread throughout the seasons, but mark:—it comes in all its glory late in August and straightway through the autumn, when we have, among many, those gorgeous genera, Solidago and Aster. Here the fact confronts us, that in the autumn the higher Sympetalæ hold sweeping predominance over the higher Choripetalæ.

Few data of any consequence have been omitted from this review, and the evolutionary system followed has been defined step by step because upon it the fabric of the argument mainly depends. The deductions are these:—*From early spring to late autumn there is a progression in the general character of the flower-groups, from the lower to the higher,—successive groups succeeding each other in time, parallel groups coming synchronously.* And the later in order may be *types* of a higher character of development, *or* they may be *specializations* of a group whose *normal* forms belonged to an earlier season. In their blooming season, *the more perfect succeed the more simple; the aberrant, the normal; the specialized, the generalized.* But with the general observation arise certain modifying conditions. The blooming period may sometimes vary from the general rule to better bring the flowers among the most favorable conditions for cross-fertilization,—in the case of anemophilous pollination before referred to; or, even more obviously, in the case of entomophilous pollination, though here it is often doubtful whether the flower adapts itself to the insect's season or vice versa. Again, plants that are frontiersmen from the characteristic vegetation of a hotter clime may be expected in the hottest of the seasons,—e. g.: the Cactaceæ. There is an evident limitation of the flowering of our trees and shrubs to spring and earliest summer. This may largely be due to the excess of vital energy held stored up in woody trunks and branches,—and in Coniferæ in the evergreen foliage,—ready to burst forth with the first coming of warmth. Diclinism is most frequent in the spring months,—where this occurs in the lower groups of plants the case is covered by the general principle; but when diclinism obtains in highly specialized forms, as a result of retrogressive evolution, the problem becomes difficult,—the interesting question suggests itself: Does reversion in structure here revert the flowering period to an earlier season? As a case in point, recall the genus Carex. Again, there is a determining function in the character of the flower's habitat:—The spring flowers seek largely the protection of the woodlands; marsh-plants reach perfection mainly in latest spring and through the summer, though some, like Caltha, are early; the aquatics of ponds and river glory in the summer sun; and the flowers of meadow and prairie and thicket-margin luxuriate from mid-summer to the end of autumn. This last recalls the recent observations of Conway McMillan on "tension-line flora," and we note with interest that the highly organized tension-line flora gives us our later blossoms to a large extent. Further, every practical botanist knows that the herbaceous flora of summer, as a whole, shows a great advance in *vegetative* luxuriance over the corresponding flora of spring. But it does not follow that that of fall in turn advances, for vegetative luxuriance means primarily—heat. Yet the truth remains that this is not the fundamental criterion of plant aristocracy,—in the giant calamite of geologic ages flowed humbler blood than flows to-day in the dandelion of our backyard grass-plots. So each new factor that arises, far from weakening, but adds significance to the fundamental principle.

Here the question rises: Why should there be a correspondence between the course of the flower seasons and the system of floral evolution? Solve this, and the "philosophy of flower seasons" is an open riddle. But for the present it is only possible to indicate the direction in which the answer probably lies: The most simple and generalized forms, coming first in the course of floral evolution, have had the longest time in which to adapt themselves to existent climatic conditions;

and, reciprocally, climatic conditions have become more and more favorable to the rapid development of the said forms. So a floral type that ages ago would have reached its perfection only after a long continuance of favoring season, now may burst into the fulness of its maturity with the first warmth of spring. But as change succeeded change in the course of time, a maximum point would be reached, from which the conditions would become less and less favorable to the rapid development of types surviving from an earlier age. Then these would dwindle from the earth,—replaced, driven out, by those that had come into existence in a later age. Thus, in the ages to come, the early flowers of to-day will disappear; to be replaced by what are now our later flowers; whose place, in turn, will be filled by forms that are yet to be. All this is but a bare suggestion, yet in it may be, perchance, the spark of truth that will guide further observation to a more definite decision.

This very relation between flowers and seasons that the evolutionary floral system brings to light, may, in turn, modify somewhat that system, and so eradicate many seeming anomalies. And thus the added law may be better established by the perfecting of the fundamental one,—and vice versa. This consideration cannot be ignored.

In the light of all these facts and their regulating principles we can feel with fullest power that harmony of relations in the flora of each succeeding month,—a harmony to which even the casual observer cannot be insensible. The quarter of our country we have scanned is a wide sweep—coast-plain, hill-regions, mountains, and prairie; and if it offers so significant suggestions we can justly say, inductively, that there must be much here that is of far wider application. At least, there is full cause to believe that more extended research in this little-tested field of flower philosophy will be well repaid; and it may, further, open up an analogous field, yet unthought-of, in the realms of lower, flowerless, plant-life. The story told, we realize that its plot is simply another instance of the expression of universal law in that which rather seems a law unto itself.

THE MORPHOLOGY OF ROOT TUBERCLES OF LEGUMINOSÆ.

ALBERT SCHNEIDER, M. D.[1]

The object of this research was to give a more detailed account of the anatomical structure of root tubercles, thus adding perhaps somewhat toward clearing up some of the difficulties in the comparatively little known field of teratology. It is true much labor has been expended in the endeavor to get a correct understanding of "symbiosis" and the relation of *Rhizobia* to certain plants. The life history and morphology of the root bacteria have received most of the attention while the tubercles themselves have been almost entirely forgotten. Frank, who has done much in this line of research offers but little concerning tubercle morphology. Nearly all of his attention is directed toward the "*Bakteroiden.*" The same is true of Beyerinck, Brunchorst, Waronin and the others. Some of the pupils of Frank have also made noteworthy researches concerning Rhizobia. Recently Frank and Moeller[2] have engaged in a controversy with regard to the "*Dimorphismus der Wurzelknöllchen der Erbse.*" Frank has also described the lenticular structure of root tubercles. Beyond this, little of importance seems to have been done with root tubercle morphology.

In my own researches, mature tubercles were taken from various *Leguminosæ* toward the close of the vegetative period, since at that time tissues have acquired their most marked morphological characteristics. The earlier stages of development were studied at various periods of the season. The final summing up was not completed until late in the year. (Dec., 1892.)

The tubercles are in themselves abnormal growths produced by the local irritation of certain organisms, the Rhizobia; and etiologically resemble those growths produced by certain animals as for example the *Heterodora* or *Anguillula* cysts found on some roots. Morphologically, however, they are clearly distinct.

---

[1] The investigations described in this paper were carried on in the laboratories of botany, of the University of Minnesota.

[2] Berichte der deutsch. bot. Ges., Hefte 3 und 5, 1892.

In some cases these tubercles make their appearance shortly after germination. In others not until plants have reached the flowering stage or even later. In some cases they do not appear at all, that depending upon the nature of soil in which the plants grow as explained by Frank[3] and others. The macroscopic appearances of some tubercles have been more or less perfectly described in a previous article.[4] The form is quite constant in a given species of plant. In *Phaseolus vulgaris* and *Amphicarpaea comosa,* for instance, they are spherical. In *Melilotus alba, Pisum sativum, Trifolium pratense* and *Trifolium repens* they are oblong, narrow at point of attachment, often slightly forked, cordate or pear shaped. Usually they occur singly, less often, as for example in *Melilotus alba* they grow into large grape-like bunches. Like root branches they usually develop acropetally though there are numerous exceptions. They are most common on roots near the surface of the soil; sometimes they are found at a considerable depth. They are never found in close proximity to growing root tips. They occur either on the main root or its branches.

Tubercles seem always to develop exogenously. The direct causes of their development are the Rhizobia, of which there are at least several species.[5] Predisposing causes are, nature of soil and condition of atmosphere as to temperature and moisture, etc. The various kinds of Rhizobia appear to be more or less abundant in all normal soil. Whenever a given species finds a suitable lodging place on the root-surface it multiplies and by some means gains access to one or more of the surface cells and infection is completed. Just how infection takes place is not definitely known. It is thought that the Rhizobia have the power to dissolve the cell membrane of the host; just how is not stated. Frank, Moeller[6] and others maintain that infection takes place by means of the "*Infektionsfäden.*" This seems improbable since the "*Infektionsfäden*" are not always present. I could find no trace of them in *Phaseolus vulgaris.* They are sometimes present in *Trifolium pratense.* I have been unable to find them in *Robinia pseudacacia,* although Moeller states that they are present. In all those cases in which I found them I could detect no connection between them and the Rhizobia. They are sometimes found in tissues outside of the tubercle having no apparent connection with it. In chemical behavior and microscopical appearance the "*Infektionsfäden*" differ considerably from the Rhizobia. The "*Infektionsfäden*" consist of a more highly refractive albuminoid substance and stain less readily than the Rhizobia. I have often found them in old tubercles of *Trifolium pratense* in which the Rhizobia and cell protoplasm had been almost wholly removed showing that they have a greater vitality than either the plant cell or the Rhizobia. Heretofore no one has been able to detect a membrane on the "*Infektionsfäden.*" Recently Moeller[7] has announced the discovery of a cellulose membrane surrounding the "Bacteria zoogleæ"—"*Infektionsfäden.*" This membrane, he asserts, is secreted by the cell protoplasm as a protection against the intruding bacteria (Rhizobia). In the same article Moeller notes that the bacteria (Rhizobia) have the power to dissolve cellulose. These statements are certainly a little difficult to understand. It would seem improbable that the bacteria (Rhizobia) should at one and the same time dissolve cellulose and also have a coating of it deposited on them as a protection against their intrusion. It is known that eggs of parasites, larvæ in the resting stage, calcium oxalate crystals, etc., when found in plant tissues have had secreted around them a coating of cellulose. In such cases, however, the foreign substance does not at the same time have the power of dissolving cellulose.

---

[3] Pilz symbiosa der Leguminosen, 1890.

[4] Bulletin Torrey Bot. Club, July, 1892.

[5] Bulletin Torrey Bot. Club, July, 1892.

[6] Ber. der deutsch. bot. Ges., Heft 5, 1892.

Without going into further discussion, it is known that the Rhizobia gain access to the interior of the surface root-cells where they multiply rapidly. By their irritating presence, increased protoplasmic action takes place. Not only do the infected cells grow and multiply much more rapidly but the adjoining cells likewise take on increased activity. On microscopic examination there will be noted a slight protuberance, swelling outward but still covered by the root epidermal layer. This incipient tumor consists of two kinds of meristematic tissue, the centrally located portion of infected cells and the adjoining outer portion of noninfected cells. This meristem tissue is engaged in active cell division. The original infected cells divide and produce auto-infected daughter cells. Outwardly a corky tissue is developed from a distinct phellogen layer, usually one or two cells in thickness. These phellogen cells divide tangentially and often contain starch and calcium oxalate crystals. I have found a cork layer on all tubercles examined thus far. Centrally cell division goes on less rapidly until the pericambium of the root is reached which is also involved in the change. A vascular bundle starts from the root-vascular system and extends peripherally toward the infected area until quite near it where it divides into from four to seven branches which continue centrifugally (in reference to root) through the outer part of the tubercle meristen to near its apex. These vascular bundles consists of conducting vessels, like those of the root, surrounded by bast cells: the whole is encircled by a sheath of cells whose outer walls are considerably thickened.

---

[7] Ber. der deutsch. bot. Ges., Heft 5, 1892.

In spherical tubercles the cambium is of equal thickness in all parts. In elongated and irregular forms the meristematic tissue is more abundant in the extended points, that is, there may be one or more apical areas in the same tubercle. The cambium cells are of the ordinary small, angular, closely united, rather thin walled variety. The cells may divide in any plane. The cork layer usually consists of thin walled rectangular cells, often with intercellular air passages. In *Phaseolus vulgaris* the cork cells are considerably rounded, in Robinia they are rather irregular. The entire cork layer is continuous with the unchanged endodermal layer of the root. The entire tubercle is covered over by an epidermal layer of cells contiguous with that of the root. No root-hairs are present. Early in the development of the tubercle the root-hairs become dwarfed and soon disappear. The plant can no longer use them as organs of absorption on account of the impervious layer of cork. The tubercle receives its nourishment by means of the vascular bundle system and the parenchymatous conducting tissue of the root which is continuous with that of the tubercle. The outline of the infected area is wavy, there being a depression before each vascular bundle as seen in a cross section. Single, or groups of noninfected cells are generally distributed through the infected area. In the centre may be found a noninfected area of considerable size, as in *Robinia pseudacacia.* The infected cells resemble those of the noninfected cambium in that they are angular and closely united, there being no intercellular spaces. They differ in that they are much larger and in that they have undergone peculiar protoplasmic and nuclear changes. The cells are entirely filled with Rhizobia and protoplasm. The Rhizobia feed upon the cell protoplasm and in turn appropriate for the use of the plant the free nitrogen of the air. In the case of *Rhizobium mutabile* the abundant food supply causes it to become much enlarged and to assume various forms during the season, hence the name. No other species seem to undergo such extensive changes. As to the position the Rhizobia take in the cell, I have noticed some peculiarities. In colonies of *Rhizobium mutabile* in *Melilotus alba* the long axes are all directed toward the nucleus. *Trifolium* which contains the same species of Rhizobium does not show the same arrangement. Here they are placed in all concievable positions. Why they should take this position in *Melilotus alba* I am unable to state. In *Phaseolus vulgaris* and *Pisum sativum* they are often collected into Zoogloeae as is clearly shown in thin sections.

In *Amphicarpaea comosa* and *Phaseolus vulgaris* I have always found well developed lenticels on the tubercles. They are developed from a clearly marked lenticular phellogen, showing tangential cell division. The phellogen of the lenticels as well as that of the cork layer is developed from a large celled parenchymatous tissue lying above the cambium layer. The lenticular phellogen is not depressed into the underlying tissue, as is usually the case, but somewhat elevated above it. The lenticels consist of the usual loosely connected, rounded cork cells and are always located above the vascular bundles. They no doubt serve as a means for the interchanging of gases between the exterior and interior by way of the vascular bundles. Frank maintains that the cork layer as well as the infected area have intercellular air spaces for the interchange of gases. As already mentioned the infected area consists of closely united firm walled cells, such as are usually found in meristematic tissues. Furthermore the infected area is entirely cut off from the cork layer by means of the cambium which certainly has no intercellular passages. Hence it would be rather difficult to see what function intercellular spaces would play in the infected area. Tubercles possessing lenticels no doubt give off considerable gas. I have noticed that the tubercles of a growing bean plant when placed in water would have a glistening appearance due to a thin layer of air or some gas separating them from the water. After a time very minute gas bubbles would form on the surface of the tubercle. As to the source and nature of this gas I am unable to give any satisfactory explanation. It is very likely dependent upon the largely increased metabolic processes going on in the tubercle, Frank has made some experiments on the subject without however, coming to any definite conclusions.

Starch is usually present to some extent in tubercles, especially in those infected by *Rhizobium mutabile.* There is some in tubercles of *Amphicarpaea comosa,* little or none in tubercles of *Phaseolus vulgaris* and *Robinia pseudacacia.* The starch is always found in the noninfected meristem tissue especially the cork phellogen and next to the infected area. This is simply *stored starch* like that found in other parts of the root.

Frank maintains that there are two varieties of Rhizobia always to be found in two different kinds of tubercles of *Pisum sativum.* One variety is said to have the power of producing within itself highly refractive amyloid bodies closely related to amylo-dextrin found in some of the Florideae. Moeller agrees with Frank in regard to the presence in some Rhizobia of the highly refractive bodies but maintains that they consist of some fatty derivative, as cholesterin. Both agree that these bodies are readily stained with iodine solution, but while Frank notes a reddish brown stain Moeller affirms the color to be dark brown. I have noted similar highly refractive bodies in *Rhizobium mutabile* of *Melilotus alba, Trifolium pratense, Trifolium repens,* and *Lathyrus odoratus* but not in *Phaseolus vulgaris,* or *Pisum sativum.* These two last named plants are infected by *Rhizobium Frankii* var. *major* and *minor* respectively. So far I have only found these bodies in *Rhizobium mutabile.* These bodies are, as before stated, highly refractive; generally rounded, and may be located in the centre or toward the periphery of the usually more or less modified *Rhizobium.* I have been unable to stain them with tincture of iodine. Fuschin stains them with difficulty. The various aniline dyes have practically no effect upon them. As to their chemical nature I am not prepared to express a definite opinion. I am of the opinion that they are not starch. I am more inclined to Moeller's view that they are due to a fatty degeneration of protoplasm in improperly nourished Rhizobia. This would especially be expected in mature degenerating tubercles, which are the only ones that contain the Rhizobia with refractive bodies. Fatty degeneration is quite common in animal protoplasm. It sometimes happens that a starch granule is deposited inside of the partially or wholly empty case of a Rhizobium. This however is purely accidental and does not occur often. Of course such Rhizobia will contain highly refractive bodies that stain readily with iodine.

The greatest changes take place in the infected area of the tubercle. Here everything points to increased protoplasmic activity. The cells grow and multiply rapidly, they are entirely filled with a mixture of Rhizobia and protoplasm and in some cases the "*Infektionsfäden.*" The nuclei are abnormally large, the nucleoli become more distinct. All the different cell elements stain much more heavily than those of the normal cell. In *Phaseolus vulgaris* the nuclei becomes very much modified, they increase in size, the nuclear wall thickens, sooner or later the weaker spots of the wall give way and allow the nucleoplasm to protrude giving the whole an amoeba like appearance. Finally the nuclear wall ruptures on one side and allows the nucleoplasm to escape and mix more or less with the cell protoplasm (cytoplasm). The nucleoli retain their normal size and form; some of them retain a position next to the nuclear wall, others escape into the "mycoplasm" of Frank. I have not noticed such extensive nuclear changes in any tubercles except those of *Phaseolus vulgaris.*

The question as to what becomes of the contents of the infected cells might be briefly considered. Formerly I expressed it as an opinion that the plant at the close of the vegetative period and also at other suitable times absorbed the protoplasmic contents of the Rhizobia. I do not now think that that is the rule if it occurs at all. I believe that normally the tubercles are destroyed by the ordinary process of decay and the Rhizobia thus liberated. I have found the usual number of tubercles on *Trifolium pratense* and *Melilotus alba* as late as December 10th when I was compelled to chop them out of the frozen ground. The tubercles were filled with *Rhizobium mutabile,* apparently in normal condition. I have found well filled tubercles on dead, matured plants of *Phaseolus vulgaris.* The Rhizobia were apparently in a resting stage, waiting to be liberated. It is true in some cases the tubercles were emptied during or before the close of the vegetative period. Even in such cases I do not believe that the contents were taken up by the host but rather that the tubercles died and decayed because it did not receive enough nourishment from the plant and soil.

The question as to what position the tubercles hold, morphologically considered, is of some interest. The absence of a root-cap, of root-hairs and the fact that it develops exogenously would show that it does not resemble a root-branch. In position it shows neither positive nor negative geotropism though it occurs most frequently on roots near the surface. That may be, as Frank maintains, because the tubercles require a coating of air to keep them from direct contact with moisture. But since the tubercle is nourished by the plant and the coating of air escapes from the tubercle itself it is difficult to see why they should not develop in deep soil as well. It may be that there is a tendency toward negative geotropism. I have never been able to find tubercles on any other part of the plant than the root or its branches. Frank has found Rhizobia in stem, leaves and even the embryo. I have searched for them repeatedly in tissues outside of the root but have not found any. Tubercles resemble growing tissues in the abundance of Albuminoid compounds. Calcium oxalate crystals are common in the noninfected cambium especially the cork phellogan. Some of the crystals have a coating of cellulose secreted around them by the cell protoplasm. Any abnormal growth resembles histologically the tissue upon which it develops; hence one would expect the tubercles to resemble anatomically the roots upon which they grow. Yet it seems that the tubercles have more anatomical characters belonging to a stem than to a root, as already indicated.

RESUME.

1. Root tubercles develop exogenously.
2. Tubercles grow from a meristematic area surrounding the infected region and separating it from the external cork layer.
3. Cork as well as lenticles develop from a well marked phellogen.
4. Tubercles have a well developed vascular system differing from that of the root.
5. *Phaseolus vulgaris* and *Amphicarpaea comosa* have tubercles with well developed lenticels, differing somewhat from those on the stem.
6. There is more or less starch in tubercles produced by *Rhizobium mutabile.*
7. Sometimes *Rhizobium mutabile* contains highly refractive bodies whose nature is not definitely known.
8. Anatomically a tubercle resembles a stem more closely than a root.
9. Generally tubercles are not found empty at the close of vegetative period.
10. Probably the plant does not reabsorb the protoplasmic contents of the Rhizobia at any time.
11. Nuclei in tubercles of *Phaseolus vulgaris* undergo great changes.

EXPLANATION OF PLATES.

A. Longitudinal section of a mature tubercle of *Melilotus alba.*

a. Cork layer.
b. Phellogen.
c. Vascular bundle in longitudinal section.
d. Infected area showing the Rhizobia radiating from the nucleus as a centre.
e. Vascular bundle, cross section.
f. Apex of cambium layer.
h. Starch layer next to infected area.
i. *Rhizobium mutabile* of *Melilotus alba* as seen in the early part of November.
j. Calcium oxalate crystals.
k. Parenchymatous tissue continuous with that of the root.
r. Noninfected cells in the infected area bearing starch.

B. Cross section of a tubercle of *Phaseolus vulgaris.*

a. Cork layer consisting of rounded cells.
b. Phellogen.
c. Lenticels.
d. Infected area, Rhizobia are arranged in zoogloeae.
e. Vascular bundles, all in cross section.
g. Calcium oxalate crystals.
i. *Rhizobium frankii* var. *majus* from bean tubercle.
j. Normal nucleoli. 1. Nuclear wall. 3. Nucleoli. 4. Nucleoplasm.
k. Much modified nuclei form infected area. 1. Nuclear membrane. 2. Processes of the nucleoplasm. 3. Nucleoli. 4. Nucleoplasm.

C. Details.

1. Small portion of tubercle of *Trifolium pratense* invaded by the "Infektions fäden" (*Schinzia leguminosorum*). a. Hyphæ of the fungus. b. Enlargements next to cell wall. c. "Haustoria."

2. Diagrammatic longitudinal section of *Robinia pseudacacia.* a. Cork layer. The cells are more irregular than those of the root. c. Vascular system. d. Infected area. e. noninfected areas.

3. Same as 1, but without the "Infektions fäden" and showing the cell entirely filled with the much modified *Rhizobium mutabile.* Nuclei are much enlarged and nucleoli show distinctly.

4. b. Much modified *Rhizobia mutabilia* with highly refractive bodies c. a. Starch granule which is capped by the empty case of a Rhizobium, b. á. A starch granule just forming inside of a partially empty Rhizobium case. 'a. Some free starch granules.

5. Cross section of a vascular bundle. a. Sheath. b. Phloem. c. Vessels.

ON THE STRUCTURE OF THE CARAPACE IN THE DEVONIAN CRUSTACEAN RHINOCARIS; AND THE RELATION OF THE GENUS TO MESOTHYRA AND THE PHYLLOCARIDA.

BY JOHN M. CLARKE.

In the original account of the peculiar fossil *Rhinocaris*,[1] the carapace was described, from the best evidence then obtainable, as univalvular, with a rostrum projecting conspicuously and consolidated with the valve. The type of structure appeared to be a remarkable departure from that exemplified in the prevailing phyllocarid crustacea of the Devonian (*Echinocaris, Elymocaris, Tropidocaris*), and seemed to evince in the very structure mentioned, strong affinities with the Decapods.

The diagnosis of the genus was virtually based upon a single specimen in which the carapace had been laterally compressed in such a manner as to demonstrate the non-existence of a median suture or hinge, and to conceal any evidence of other longitudinal sutures; and in which, also, the rostrum was laterally flattened and apparently continuous with the carapace.

For several years I have been carefully searching for additional information concerning this peculiar crustacean. A considerable number of specimens from the shales of the Hamilton group of Ontario County, New York, have come into my hands, but the test of the animal is so very tenuous that it seems well nigh impossible to secure examples which have not been subjected to some distortion, and that is usually the greatest at structural points of critical importance. Several excellent specimens, however, have been obtained, some of them kindly furnished by Mr. F. B. Loomis, of Spencerport, N. Y.

The carapace of *Rhinocaris columbina* Clarke, (the typical species) consists of four distinct and separate parts; two broad lateral plates or valves, a narrow median or axial plate, and an anterior median plate or rostrum.

---

[1] Palæontology of New York, vol. vii, pp. lviii, 195, pl. xxxi, figs. 16–21, 1888.

The valves have an elongate, somewhat semi-oval marginal outline, narrower posteriorly than anteriorly, with a truncate or concave posterior extremity. They come into contact at only a single point, and that is in the axial line at about one-fourth of the median length from the anterior margin. At this point a projecting angle is formed on each by the attenuation and termination of the rostrum and median plate, and the projecting points appear to come into simple apposition, though it is possible that they slightly overlap; there is, however, no satisfactory evidence of the clasping of the valves at this point, such as that occurring in the great species *Mesothyra Oceani.*[1]

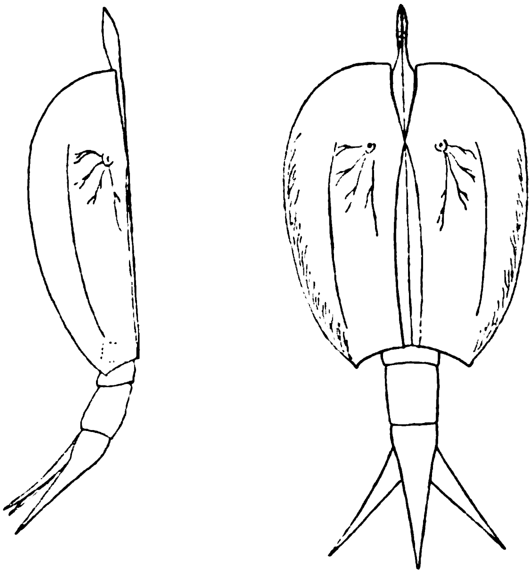


FIG. 1. **Diagrammatic figures showing the carapace structure in *Rhinocaris*.**

Opposite this point of contact and considerably within the median line of each valve, is a visual node having the form

[1] *Op. cit.* pl. xxxii, fig. 6; pl. xxxiii, figs. 4, 5.

of a low pustule with a single central depression or pit. From the base of this node radiates a series of linear, sparsely branching sinuses which extend laterally and posteriorly toward the marginal regions, the longest traversing nearly one-third the length of the valves. There is a very faint ridge or carina which lies just outside the middle of each valve and extends subparallel to the outer margin, for nearly the length of the valve, though reaching neither its anterior nor posterior margin.

In addition to these characters, the valves, over the marginal regions, bear the fine anastomosing elevated lines which characterize all the phyllocarid crustacea.

The rostrum is an elongate plate having, when flattened horizontally, somewhat the form of a willow leaf. Its broader end is inserted into the anterior gap between the valves and its posterior extremity is acute. As the plate begins to project beyond the anterior edge of the valves of the carapace, it narrows, its lateral expansions become deflected, the median portion tapering rapidly and becoming slightly incurved toward the tip.

The plane of the anterior half of the plate stands at nearly right angles to that of the posterior half, as shown in the accompanying figures. That this organ is in symphysis with the valves is evident from the fact that it is rarely found in its normal position. The surface is peculiarly ornamented by a series of elevated lines forming a sort of midrib; over the lateral posterior expansions the lines become much finer, diverge

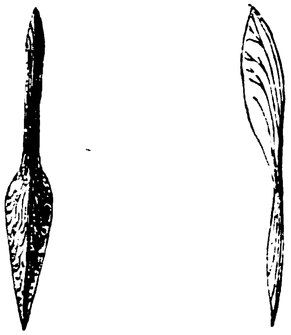


FIG. 2. Dorsal view and outline profile of the rostrum of *Rhinocaris columbina.*

radially from the center after the manner of leaf veins, anastomosing to some degree, frequently terminating in oblique punctæ, and in parts where the lines disappear the punctæ remain.

The median plate. This is a very narrow body, its width exceeding at no point the greatest diameter of the rostrum. It begins at the union of the valves, in an acute angle, but its lateral margins soon become subparallel or convex outwardly. In relative proportions its length is about eight times its width.

Along the median axis it bears an elevated ridge-like line, from which there is a gentle slope on each side, and it was essentially from this evidence of continuity of the test on the axial line and from the concealment of the sutures between this plate and the valves, that the carapace was originally described as univalvular. The fine incised lines of the surface diverge anteriorly from this ridge.

In discussing, in Volume VII of the Paleontology of New York,[3] the structure of the great carapaces from the lower Chemung beds at Ithaca, N. Y., which had theretofore been known as *Dithyrocaris neptuni*, it was shown that these carapaces (now termed *Mesothyra oceani*) must have had a composition similar to that we now find to have actually existed in

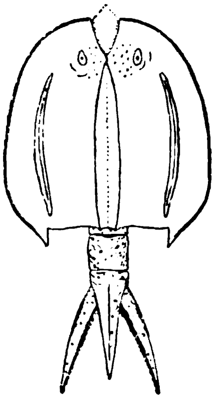


FIG. 3. *Mesothyra oceani.*

---

[3] *Op. cit.* p. 184, pl. xxxi, figs. 8–10.

Rhinocaris. This presumptive structure was exhibited in a diagrammatic figure upon Plate xxxii, of which a reduced copy is here given. Though neither the rostrum nor the median plate in *Mesothyra* has yet been seen, all doubt of their existence is removed, and it affords a personal gratification to find this reconstruction of *Mesothyra* so fully substantiated by our present knowledge of the carapace in *Rhinocaris.*

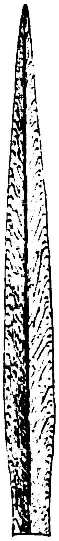


FIG. 4. The median plate of *Rhinocaris columbina.*

The structure of the visual organ affords a further correspondence in the two genera, and one of some morphological significance.

In regard to the number of abdominal segments, present evidence indicates a difference in the two, *Rhinocaris columbina* having at least three, and *Mesothyra* having shown but two.

In the genus *Tropidocaris* Beecher, it has been shown that the type species, *T. bicarinata*, possesses a rostrum,[4] and its anterior extension is not unlike that of *Rhinocaris*, but there is now no satisfactory evidence of a free median plate in any of these species. Unfortunately the accessible specimens of the species are not very satisfactorily preserved, and the originals described by Mr. Beecher in Report PP of the Second Geological Survey of Pennsylvania, are understood to be beyond the reach of further investigation for the present. In plaster casts of the originals, the median suture on the hinge appears to be invariably in the longitudinal axis of the test. The original specimens of *Rhinocaris scaphoptera* and *Tropidocaris hamiltoniæ*, which were collected by me in the Hamilton shales of Ontario County, N. Y., both show some evidence of a quite narrow median plate, and the former possesses a stout rostrum,[4] while in the *Mesothyra* (*Dithyrocaris ?*) *veneris*, from the Marcellus shales, both median plate and rostrum are distinctly seen.[5]

It may be questioned if the multicarinate carapaces composing the genus *Tropidocaris* should be placed in close association with the unicarinate carapaces such as are possessed by *Rhinocaris columbina*, *R. scaphoptera*, *Mesothyra oceani*, *M.* (*Dithyrocaris ?*) *veneris*, *Tropidocaris hamiltoniæ*, etc. All the latter appear to have possessed the carapace structure of *Rhinocaris columbina*, and if they are to be considered as representing different modifications of this type, sufficient to entitle them to distinct generic appellations, the following division of them may be preferable to that now standing: under *Rhinocaris; R. columbina*, *Mesothyra veneris;* under *Mesothyra; M. oceani*, *Tropidocaris hamiltoniæ*, *Rhinocaris scaphoptera.*

---

[4] *Op. cit.* pl. xxxi, fig. 22, 28.

[5] *Op. cit.* pl. xxxiii, fig. 3.

In regard to the unicarinate genus *Argas*, or *Dithyrocaris*, it may be stated that as described and illustrated by European writers, it has not been shown to exist in the paleozoic faunas of North America. When the structure of the carapace in the type species shall become more precisely known, we shall have a better basis for the comparison of these fossils with those under consideration, but at present we are not justified in assuming that they possessed the same structure as the unicarinate Rhinocarids.

Leaving these points of systematics, we find in *Rhinocaris* and its allies a remarkable carapace structure, an explanation of which it is difficult to find among fossil or recent crustaceans. We may conceive the double suture to have been a temporary modification of the Ceratiocarid type, induced by a necessity for movement of the lateral parts of the carapace after anchylosis has become established along the original median hinge. The evidence favors the belief that the valves were capable of motion along the double hinge, and nearly every specimen demonstrates the fact that the parts were separable along these lines after but slight maceration of the tissues.

No satisfactory elucidation of the origin and morphological significance of this structure appears from a study of the embryological phases of *Nebalia* as given by Metschnikoff, Claus and Packard, nor in the development of the Decapods as shown by Sars, S. I. Smith, Brooks, Bumpus and others. It is, nevertheless, in the development history of *Nebalia* and the

Decapods that the key to the taxonomic value of these features must be sought.

The existence of such a structure among the fossils usually classed as Phyllocarida, suggests a question as to the latitude of this ordinal term, proposed by Packard in 1879, for the living *Nebalia* and its fossil allies. The hinging, or median division by suture, of the carapace in many of these creatures, has been regarded here as among the Phyllopods, as of minor importance by most authors who have agreed to associate with *Nebalia* such fossil forms as *Ceratiocaris*, *Echinocaris*, etc. Claus used the term *Leptostraca* (also founded upon the structure of *Nebalia*) with a somewhat more restricted meaning. In a recent work on the *Ceratiocaridæ* of Great Britain, the authors, Professor T. Rupert Jones and Dr. Henry Woodward, have divided the Phyllocarida into two groups (1) those with univalved, and (2) those with bivalved carapaces. The greater number of the genera included in the first of these divisions are imperfectly known and quite obscure in their structural relations. Such are *Discinocaris*, *Spathiocaris*, *Aptychopsis*, *Ellipsocaris*, *Dipterocaris*, etc., etc. As the living *Nebalia* is univalved and without hinge, it is in this division that one would expect to find the closest approach to its structure, and it is, in fact, the case that none of the so-called Phyllocarida approaches *Nebalia* so closely in the structure of the test as the early paleozoic (Cambrian) genus *Hymenocaris*. In both, the telson is represented by a modification of three pairs of caudal spines or setæ, and both have about the same degree of abdominal segmentation, though *Nebalia* possess a rostrum, while *Hymenocaris*, as far as we now know, is devoid of one.

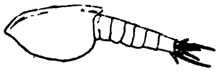


FIG. 5. *Hymenocaris vermicauda.*

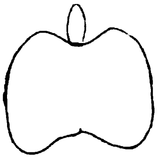


FIG. 6. The flattened carapace of *Nebalia bipes*. (After Packard.)

Another very early univalved species, not unlike *Nebalia*, but wonderfully similar to the living Phyllopod *Apus*, is the *Protocaris marshii* Walcott, from the Olenellus-zone of the Cambrian. The figures here introduced, taken from the works of Walcott and Packard, will serve to show this similarity. The

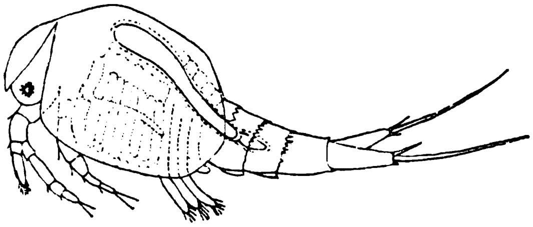


FIG. 7. Young of *Nebalia geoffroyi.* (After Metschnikoff.)

single example of *Protocaris* known, has probably been subjected to some horizontal distortion in the shale, giving the carapace a disproportionate size with reference to *Apus*, possibly also serving to obliterate any external evidence of ocular nodes which may have existed, but the remarkable closeness in the form of the abdominal segments, the degree of segmentation and the single strong pair of caudal processes, renders it highly probable that in *Protocaris*, we have to do with an apudiform phyllopod rather than with a nebalioid phyllocarid.

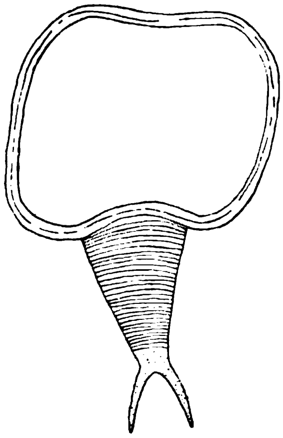


FIG. 8. *Protocaris marshii.* (After Walcott.)

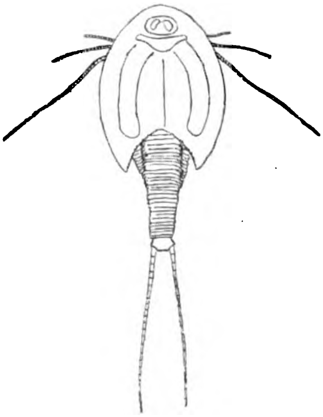


FIG. 9. *Apus æqualis.* (After Packard.)

Among the bivalved genera, not including *Estheria* and *Leaia* which Messrs Jones and Woodward have placed with the Phyllocarids, there is throughout a general resemblance to

Nebalia except in this division of the carapace; a rostrum was present in most, though in some, as *Echinocaris*, a large amount of material has as yet failed to establish its existence. *Nebalia* possesses stalked compound eyes, which make no node or other configuration upon the exterior of the carapace. In *Echinocaris*, one of the numerous nodes in the cephalic region is undoubtedly ocular, and sometimes shows a slight depression at its summit; the other nodes are probably of muscular origin.

In *Ceratiocaris* there is no external evidence of eyes, while *Emmelezoe*, *Tropidocaris* and *Elymocaris* all possess nodes which may be definitely referred to the ocular organ.

Figures of *Emmelezoe* given by Jones and Woodward indicate that its structure is similiar to that of *Rhinocaris*, and it is evident that differences of structure in this respect between all of these genera and *Mesothyra* as represented in the accompanying figures, is simply one of degree. It is, therefore, a pertinent query whether such a fixed external ocular body as this, with a single central depression, is in any way indicative of stalked compound eye. We are strongly of the opinion that it is not, but, rather, indicates that these ancient representatives of nebaliad structures were sessile eyed.

Among the crustaceans we have been considering there appear to be at least four types of test-structure which are well distinguished.

1. That of *Apus* (*Protocaris;* a synthetic type, not necessarily a Phyllopod because *Apus* is one.
2. That of *Nebalia*, in a restricted sense (*Hymenocaris*).
3. That of *Ceratiocaris* (*Echinocaris*, *Elymocaris*, etc.).
4. That of *Rhinocaris* (*Mesothyra*, *Dithyrocaris ? ?*).

It was proposed, when *Rhinocaris* was believed to represent a univalved, rostrate carapace, to distinguish it not only as a genus, but as a separate family, *Rhinocaridæ*, from other Phyllocarids; and it was at the same time proposed to place *Mesothyra*, with a supposed structure which we have now shown to exist in *Rhinocaris*, in a distinct family, the *Pinnicaridæ*. It is now evident that the two fossils are very closely related and it will not do to separate them by more than a generic difference; we may therefore retain the family term *Rhinocaridæ* and discard the other.

GENERAL PHYSIOLOGY AND ITS RELATION TO MORPHOLOGY.[1]

BY C. O. WHITMAN.

It is only as a zoologist that I venture to discuss this subject; and only in this capacity that I undertake to defend the proposition, that *general zoological physiology* is the promising field in which morphology and physiology may work most profitably together.

Morphology and physiology are two quite distinct sides of biology, each with definite and constant peculiarities of method and aim; but these two sides are only the statical and the dynamical aspect of one and the same thing; one presents the *feature*, the other the *expression*. It is only as a matter of convenience that these two aspects are dealt with separately; they are complemental, and have their full meaning only when united. The same function may appear in different forms, but a knowledge of the forms is nevertheless indispensable to an understanding of the function, and, conversely, the function must be known before we can arrive at a complete interpretation of the form. The best interests of biology demand that morphology and physiology should be kept in working contact. That is the lesson of the hour, which thoughtful investigators on both sides are coming more and more to realize. The separation of these two great branches of biology has been carried to an extreme that impedes the progress of both—an extreme that is unnatural and that has resulted from keeping physiology too exclusively in the service of medicine.

Physiology has come to mean, in practice at least, little more than the science which treats of the functions of fully developed organs. That this is an important side of physiology goes without saying, but there is another side no less important, which has been hitherto left almost wholly to morphologists. That we have to deal with functions of organisms as well as with functions of organs, is a truth that could not escape the student of Darwin's or Wallace's works. Still we have just begun to heed the fact that the broader physiology of the future must include the biological economy of organisms as well as the functional economy of organs. I repeat *the biological economy of organisms* must become an integral part of physiology, not only in theory, but in practice as well.

---

[1] From the Fifth Annual Report on the Marine Biological Laboratory of Wood's Holl, 1892.

The activities and inter-relations of *organisms* bear the same relation to their morphology, as do the functions and correlations of *organs* to their anatomy. The former activities differ from the latter only in degree, just as an organism differs from an organ only as a composite differs from a simple. As the morphology of organisms includes organology, so the physiology of organisms embraces the functions of organs. As the one covers all organic forms from the most minute and simple up to the most highly differentiated and complex, so the other covers all vital phenomena, whether manifested in the smallest particle of living protoplasm, in a cell, a special tissue, an organ, an organism, a species, or any group of organisms. Form and function are always the two aspects, inseparably linked together throughout the entire organic world.

The work of the physiologist runs perfectly parallel with that of the morphologist, and wherever the one divides there the other divides, and for precisely similar reasons. We have the morphology of adult individuals, likewise the physiology; we have the morphology of the developing individual (ontogeny), likewise embryological physiology (" physiontogeny "); then we have the morphology of the species (phylogeny), and along side the physiology, or the phylogeny of functions (" physiophyly, " Haeckel).

Metaphysiosis[2] is as old and as universal as metamorphosis, and to attempt to explain functions as we find them to-day without considering their historical development, is in many cases at least, as idle as trying to account for the specified forms of existing organisms without the aid of their genealogy. Monumental failures of this kind might be cited on both sides; but it may be said that morphologists have almost universally abandoned this standpoint, while physiologists have quite generally adhered to it. It is the one-sided anthropocentric development of physiology that has retarded its progress, and that still waits to be corrected. Presumptuous as such statements may appear, coming from a morphologist, they are nevertheless true and must be declared so long as the malady of one of the twin branches of biology remains as the affliction of the other. So long as such fundamental functions of organisms as heredity, variation, adaptation, are neglected by physiologists, so long will physiology have to bear the reproach of having some of its more inviting fields pre-occupied and developed by morphologists.

---

[2] This word suggests itself so readily, that it will hardly be recognized as novel; it is at least self-defining.

What processes of life are more universal or more fundamental than those exhibited in and about the dividing nucleus? What function of living protoplasm has more to tell us about how the organism comes into existence and how the foundation is laid for the development of all the higher functions, than that of cleavagé? What phenomenon of life stands more in need of a physiological explanation than that of sex differentiation? What question has a more direct practical bearing on the education and development of the human race than that of the transmission of acquired characters? What functions of more transcendent interest than those of the various sense organs? Where could a more beautiful example of the evolution of function be found than is furnished in our special senses? How intensely interesting the subject of the derivation of such functions! Will the physiologist, or his protègè the psychologist, give a share of attention to these important matters, or must the morphologist not only find the problem but work it out whenever it falls within the range of evolution? That would mean working under all the disadvantages attending the separation of two co-ordinate branches which are complemental one to the other. Morphology would lose its natural helpmate, and physiology would forsake its best guide. Morphology analyses the organic machine and thus lays the foundation for understanding its physiological use; physiology puts the suggestions of morphology to the test of experiment, and elucidates the dynamical side of the machine. What the machine consists of and what it can do, go together to make up a full concept of its structure and its functions. But the concurrence of the two sciences does not stop here. Morphology raises the question, how came the organic mechanism into existence? Has it had a history, reaching its present state of perfection through a long series of gradations, the first term of which was a relatively simple stage? The embryological history is traced out and the paleontological records are searched until the evidence from both sources establishes the fact, that the organ or organism under study is but the summation of modifications and elaborations of a relatively simple primordial. This point settled, physiology is called upon to complete the story. Have the functions remained the same throughout the series, or have they undergone a series of modifications, differentiations, and improvements more or less parallel with the morphological series? To answer this question, physiology has to appeal to the same sources of evidence as does morphology, namely, paleontology and embryology.

The paleontolgical series of forms cannot of course be experimented with; but form and function are so correlated that the latter may often be inferred from the former, and *vice versa.* The embryological series, often including free larval stages, furnishes one of the grandest fields for experimental study. Here the physiologist has an opportunity not only to study by experiment but also by direct observation and inference, and thus to join hands with the morphologist both in methods and results.

We are compelled to recognize different *orders* of individualities,—as the cell, the tissue, the organ, the organism, the corm—and of course every order must have its physiology as well as its morphology. Morphology and physiology are co-extensive, each claiming the whole organic world—as it was, as it is, and as it becomes. So long as we contradistinguish form and function, we must abide by the logic of definition. We cannot reduce the circumference of the animate world, however many radii and concentric circles we draw around our specialties. We may limit the province but not the realm. If we limit our study to man, we do not annihilate his relations to the rest of the animate world. Human physiology and human morphology represent only the latest terms of series stretching back to remote initial terms. The complexities of structure and function of the later terms we can never hope to understand until, through the study of a sufficient number of mean terms, we are able to determine the initial ones.

Three general series, each more or less incomplete, are accessible to study: (1) The systematic series, consisting of adult organisms, (2) the paleontological series, and (3) the developmental series. Morphology approaches these series by *comparative* study, and seeks to make each contribute as complete a story as possible. The same sources and the same method are open to physiology. The importance of the comparative method in physiology and the intimate co-relationship of physiology with morphology are well exemplified in a charming little treatise by Metschnikoff on "*La Pathologie Comparée de l'Inflammation*"—a work that must be reckoned as one of the fairest gems that adorn the annals of the Pasteur Institute. This monumental work shows how medicine itself must take its lessons from *comparative biology*, and approach its work from the standpoint of evolution.

The history of morphology and physiology is one continuous illustration of their inter-dependence. When the famous Harvey was asked what led him to think of the circulation of the blood he at once referred the original suggestion to one of the morphological features of the vascular apparatus—the valves and their arrangement. The hint furnished by structure was then followed up and tested by experiment, and the result was a discovery that brought the position of valves, pulsation of the heart, effects of ligatures, and other facts into rational relation to one another.

The history of theories of generation furnishes a capital example of how physiological speculation has been guided, checked, and corrected by morphological discovery. The old doctrine of preformation, or pre-existence of organisms in the germ, and the notion of the inclusion of one germ preformation within another, was certainly strongly suggested by the unfolding of plant buds and by the metamorphoses of insects; but as soon as it became possible to examine more minutely the phases of development, it was found that the fine-spun theories of Bonnet and Haller were refuted by morphological facts, and the doctrine of epigenesis, defended by Aristotle and Harvey, was led to triumph through the observations of Caspar Friedrich Wolff.

Our special senses have afforded one of the most fertile fields for speculative physiology. It is needless to dwell on antiquated hypotheses of " vital spirits " residing in the nerves, of a subtle nervous humor, or " imponderable fluid " drawn from the blood and secreted by medullary matter (Cuvier). The history of the hypotheses of life, sensation and volition are largely, as Whewell has well remarked, " the story of the *failures* of physiological speculation. " It is to the cultivation of the morphological sciences that physiology owes in a very large measure, its deliverance from the temptation to stray into the region of metaphysics.

As morphology furnishes the ground structure on which physiology operates, it naturally takes the place of pioneer and guide; but if permitted to wander too far in advance, it soon finds itself entangled with physiological problems with which it is not prepared to cope, and its efforts to release itself often end in sterile speculation. The workers on both sides should therefore advance abreast, in hand to hand contact. It is only in such reciprocally helpful relations that specialists can attain the highest possible individual development, and it is only when morphological and physiological experience and knowledge combine, that biology can accomplish such brilliant feats as that of Cuvier in reconstructing an extinct organism from its fragmentary remains.

The association of morphological and physiological research enlarges the field of vision on both sides, reduces the chances of useless labor, corrects false notions, stimulates inquiry, converts half views into whole views, and withal secures mutual respect.

RECENT BOOKS AND PAMPHLETS.

Agassiz, A.—Studies from the Marine Zool. Laboratory XXIX. Preliminary Note on some Modifications of the Chromatophores of Fishes and Crustaceans. Extr. Bull. Harv. Mus. Comp. Zool. Vol. XXIII, 1892.

Albert, S. A. er Prince de Monaco.—Projet d' Observatoires Météorologiques. Extr. Comptes rendus Acad. des Sciences t. CXV, 1892. From the author.

Allen, J. A.—Description of Four New Species of Thomomys, with Remarks on other Species of the Genus.——List of Mammals Coll. by Mr. C. P. Rowley in the San Juan Region of Colorado, New Mexico and Utah, with Descriptions of New Species. Extr. Bull. Am. Mus. Nat. Hist. Vol. V, 1893. From the author.

Baldwin, C. C.—Review Extraordinary of "Man and the Glacial Period" by a member of U. S. Geol. Surv., with Annotations and Remarks thereon. No date given.

Becker, G. F.—Finite Homogeneous Strain, Flow and Rupture of Rocks. Extr. Bull. Geol. Soc. Am. Vol. 4, 1893. From the author.

Bell, A. G.—Address upon the Condition of Articulation Teaching in American Schools for the Deaf. Delivered at the Second Summer Meeting of the Am. Ass. to promote the teaching of speech to the deaf, 1892. Boston, 1893. From the author.

Braun, M.—Bronn's Klassen und Ordnungen des Thierreichs. Vierter Band, Würmer. Sechster Band, IV Abth. Vögel. Leipzig, 1893.

Broadhead, G. C.—The Correct Succession of the Ozark Series. Extr. Am. Geol., 1893. From the author.

Brunner, L.—The More Destructive Locusts of America north of Mexico. Bull. 28, U. S. Dep't. Agri. Div. Ent. Washington, 1893.

Cary, A.—A Study in Foot Structure. Extr. Journ. Morph. Vol. VII, 1892. From the author.

Chapman, H. C.—Notes on *Choeropsis liberiensis* (Morton). Extr. Proceeds. Phila. Acad., 1893. From the Acad.

Claypole, E. W.—Prof. G. F. Wright and his Critics. Extr- Pop. Sci. Monthly, 1893. From the author.

Cook, O. F. and G. N. Collins.—The Myriapoda Collected by the United States Eclipse Expedition to West Africa, 1889 and 1890. Extr. Ann. New York Acad. Sci. Vol. VIII, 1893. From the author.

Darton, N. H.—The Magothy Formation of Northeastern Maryland. Extr. Am. Journ. Sci. Vol. XLV, 1893. From the author.

Dixon, S. G.—Involution Form of the Tubercle Bacillus and the effects of subcutaneous Injections of Organic Substances on Inflammations. Extr. Poceeds. Phila. Acad., 1893. From the author.

Dudley, T. H.—Three Critical Periods in our Diplomatic Relations with England during the late war. Extr. Penn. Mag. Hist. and Biog., 1893. From the author.

Gilbert, G. K.—The Moon's Face. A Study of the Origin of its Features. Extr. Philosoph. Soc. Washington, Bull. Vol. XII, 1893. From the author.

Goes, A.—On a Peculiar type of Arenaceous Foraminifer from the American Tropical Pacific, *Neusina agassizi*. Extr. Bull. Harv. Mus. Comp. Zool. Vol. XXIII, 1892. From Alexander Agassiz.

HILL, R. T.—Clay Materials of the United States. Abstr. Min. Res. U .S., Calender Year 1891-Div. Min. Stat. and Tech. From the U. S. Geol. Surv.

HOLBROOK, M. L.—The Structure of the Red Blood Corpuscles of Man. Extr-Proceeds. Am. Soc. Micros., 1892. From the author.

HUDLESTONE, W. H.—Address delivered at the Anniversary Meeting of the Geological Society of London, Feb. 17, 1893. Prefaced by the Announcement of the Award of the Wollaston Medal, the Proceeds of the Donation Fund, the Lyell Medal and Geological Fund, and the Bigsby Medal for the same year. London, 1893. From the author.

Idaho University Agricultural Experiment Station. Bulletins No. 1 and No. 2, Dec., 1892.

JONES, H. L.—Catalogue of the Phanerogams and Ferns of Licking.

LYDEKKER, R.—On a Dinosaurian Vertebra from the Wealden of Hastings. Extr. Quart. Journ. Geol. Soc. Vol. XLIX, 1893.——Remarks on some recently described Extinct Birds of Queensland. Extr. The Iris, 1892.——On the Extinct Giant Birds of Argentina. Extr. The Iris, 1893.——On the Zeuglodont and other Cetacean remains from the Tertiary of the Caucasus. Extr. Proceeds. Zool. Soc. London, 1892.——Recent Advances in Knowledge of the Ichthyosaurian Reptiles. Extr. Natural Science Vol. I, 1892. From the author.

MALLY, F. W.—Report on the Boll Worm of Cotton (*Heliothis armiger* Hübner). Bull. No. 29, U. S. Dept. Agri. Div. Ent. Washington, 1893.

MARTIN, J. B. (MRS.)—Brief Sketches of the Life of Victoria Woodhull. From the author.

NUTTING, C. C.—Plan of Proposed Scientific Explorations under the auspices of the State University of Iowa. From the author.

OMBONI, G.—Achille de Zeno. Cenni Biografici estratii dal Discorso d' Apertura della Riunione della Società Geologica Italiana in Vicenza nel Settembre, 1893. From the author.

Oregon Agricultural Experiment Station. Bulletin No. 25, April, 1893.

OSBORN, H. F.—*Aceratherium tridactylum* from the Lower Miocene of Dakota. Author's Ed. Extr. Bull. Am. Mus. Nat. Hist. Vol. V, 1893.——What is Lophiodon? ——Is Meniscotherium a member of the Chalicotheriodea? Extr. Am. Nat. 1892. From the author.

PACKARD, A. S.—The Life History of Certain Moths of the Family Cochliopodidae, with Notes on their Spines and Tubercles. Proceeds. Amer. Philos. Soc., 1893.——Studies on the Transformations of Moths of the Family Saturniidae. Extr. Proceeds. Amer. Acad. Arts and sciences, no date given. From the author.

PILSBRY, H. A.—Preliminary Outline of a New Classification of the Helices. Exta. Proceeds. Phila. Acad., 1892. From the author.

POULTON, E. B.—Further experiments upon the color relation between certain lepidopterous larvæ, pupæ, cocoons, and imagines and their surroundings. Extr. Trans. Ent. Soc., London Pt. IV, 1892. From the author.

Records of the American Society of Naturalists, Vol. I, 1893. From the Society.

Report of the Commissioner, U. S. Commission of Fish and Fisheries for 1889, 1891. From the Dept. Interior.

Report of the National Academy of Sciences for the year 1892.

Rhode Island College of Agricultural and Mechanic Arts. Experiment Station. Bulletins No. 21 and No. 22, Feb., 1893.

ROSE, C.—Beiträge zur Zahnentwickelung der Edentaten. Extr. Anat. Anz. 1892. From the author.

SARASIN, P. UND F.—Uber das Gehörorgan der Caeciliiden. Abdruck aus Anat. Anz. 1892. No. 25 and 26. From the authors.

SCHLOSSER, M.—Uber die systematische Stellung der Gattungen Plesiadapis, Protoadapis, Pleurospidotherium und Orthaspidotherium. Separat-Abdruck aus dem Neuen Jahrbuch für Mineralogie, Geologie und Paleontologie, 1892. From the author.

SHUFELDT, R. W.—The Chionididae. A Review of the Opinions on the Systematic Position of the Family. Extr. The Auk, Vol. X, 1893. From the author.

SIBLEY, H. L.—The Grounds of Divorce. Extr. April Methodist Review, no year given. From the author.

STEJNEGER, L.—Preliminary Description of a New Genus and Species of Blind Cave Salamander from North America. Extr. Proceeds. U. S. Natl. Mus. Vol. XV, 1892. From the Smithsonian Museum.

TOPINARD, P.—De l' Evolution des molaires et prèmolaires chez les Primates et en particulier chez l homme. Extr. de L' Authropologie, 1892. From the author.

WARD, H. B.—Preliminary Communication on the Host of *Nectonema agile* Verr. Extr. Proceeds. Am. Acad., 1892. From E. L. Mark.

WHITE, D.—A New Taeniopteroid Fern and its Allies. Extr. Bull. Geol. Soc. Am. Vol. IV, 1893. From the author.

WINCHELL, N. H.—The Geological and Natural History Survey of Minnesota. Twentieth Annual Report, for the year 1891. From the author.

WOOLMAN, L.—Fresh Water Diatomaceous Deposit from Staked Plains. Extr. Am. Nat., 1892. From the author.

RECENT LITERATURE.

Conquest of the Vegetable World.[1]—This volume forms one or the series *Etudes d'Histoire Générale.* The author, M. Louis Bourdeau, treats the subject under twelve different heads, classifying plants according to the use made of them by man. The introduction gives a general theory of the increase of plants, both naturally and by cultivation. Following this are successive chapters on plants used directly as food and those from which food is manufactured in the form of liquors, oils and sugars; the fodder plants and those from which extracts are made, to be used medicinally, or as perfumery; plants useful for the arts and industries, and those which subserve merely ornamental purposes. The work concludes with a chapter on the creation and preservation of artificial varieties of some types of plants.

Report of the Minnesota Geological and Natural History Survey for the Year 1891.[2]—This quarto publication of 344 pages comprises reports on the crystalline rocks and the oxide of manganese, by Mr. N. H. Wilson; the Mesabi iron range, by H. V. Winchell; a record of field observations in four granite areas, with a catalogue of rock specimens, by Mr. U. S. Grant; a sketch of the costal topography of the north side of Lake Superior, with special reference to the abandoned strands of Lake Warren, by Mr. A. C. Lawson; a composite paper on the Diatomaceae of Minnesota Inter-glacial peat; and the usual lists of additions to the Museum and library.

The iron-ore interests have developed so rapidly that the Survey has found it incumbent to pay close attention to the geographic distribution of the rocks carrying this ore, and to the questions relating to their geology. Hence the more important papers in this report are the ones bearing upon those subjects.

The Vertebrate Paleontology of the Llano Estacado.[3]—This report embraces the determination of the species, from the most available parts of the skeleton, of the vertebrata found by the party of the Geological Survey of Texas of 1892, which explored the eastern border of the Staked Plain from the Texas Pacific R. R. on the south to the Denver and Fort Worth road on the north. The party was under the direction of Mr. Wm. F. Cummins, who was accompanied by Professor Cope. They examined exposures of the beds of the Trias, and of Cenozoic beds of the terranes Loup Fork, Blanco and Equus, together with a bed between the Loup Fork and Blanco. The number of species obtained from each of these horizons is as follows: Trias, 7; Loup Fork, 17; Blanco, 16; Equus, 10; bed between Loup Fork and Blanco, 8; total, 58. Of these, eleven were not regarded as determinable. Of the forty-seven species determined, the following were first discovered by the explorations of the geological survey; Trias, 4; Loup Fork, 3; intercalated bed, 3; Blanco, 14; Equus, 5: total, 29. Among the results we find the following. The establishment of a peculiar species of *Episcoposaurus* from the Trias. The discovery of a Tetrabelodon, not previously known to be of Loup Fork age, allied to the *T. serridens.* The determination of the range of variation of the dentition of the *Protohippus placidus,* and the determination of the temporary dentition of Protohippus and Hippotherium. The more important results obtained from the bed intercalated above the Loup Fork is the finding of a new species of Protohippus, Hippidium, and Equus, each; the last named allied to the *E. minutus*; the discovery of new genera of Mustelidae and Hyaenidae from the Blanco bed; the rehabilitation of the *Tetrabelodon shepardii* Leidy hitherto known from a single molar tooth; the species being found to resemble in some respects the genus Dinotherium. Also the determination of three other mastodons from the Blanco bed, and of a large new species of camel of the genus Pliauchenia; the discovery of a true horse (*Equus minutus* Cope) not larger than a sheep. The Equus bed yielded a huge Mylodon, represented by fragments only, four species of horses, and three of camels of the genus Holomeniscus, two of the last named being new to science.

---

[1] Conquête du Monde Vegetal. Par Louis Bourdeau, Paris, 1893. M. Felix Alcan, Editeur.

[2] The Geological and Natural History Survey of Minnesota. The Twentieth Annual Report, for the year 1891, Minneapolis, 1893.

[3] A Preliminary Report, by E. D. Cope. From the fourth Annual Report of the Geological Survey of Texas (1892); published July 1st, 1893.

Twenty-three plates illustrate the report, which add much to its value, although little can be said in favor of their artistic merits, as they are printed on ordinary paper.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Recent Volcanic Eruptions in California.—In a paper published in *The Independent*, Professor G. Frederick Wright makes the following remarks concerning recent volcanic eruptions in California:

"The absence in America of volcanic phenomena east of the Rocky Mountains is amply compensated for by their abundance west of them. Probably the largest lava fields in the world are situated in Idaho, Washington, Oregon, California and Nevada. In age these belong to the latest of the geological periods, being for the most part tertiary. For many reasons there is much interest in determining how near down to the present time these volcanic eruptions have continued.

"The traveler over the lava beds of the Pacific slope cannot fail to be impressed by the fresh appearance of the basalt which covers so large a part of the surface. Considerable areas can readily be found whose surface looks as fresh as that of the slag from the furnace of yesterday. Many reports have been set in circulation by travelers that some of the volcanic cones have been witnessed by them in active eruption. Thus the members of Astor's party who, in 1811, crossed the Teton Mountains just south of the Yellowstone Park, averred that they saw peaks to the north of them sending forth volcanic smoke and vapor. As they were men of large experience, some men of science have been inclined to give credence to their opinion, and are confirmed in this view by the fresh appearance of some of the craters in the vicinity of Mount Jefferson, on the shores of Henry's Lake; while the activity of the geysers in the Yellowstone Park is perhaps indicative of the continued activity of volcanic forces throughout that general region.

"But there are so many phenomena that may be mistaken for volcanic smoke and vapor when seen from a distance that it is safer not to credit such general statements. Clouds and drifting snow might easily deceive a distant observer. It is probably thus that the reports originated concerning the volcanic activity of Mount Hood during the middle of this century. Mount Hood is indeed a volcanic crater; but so far from being active it is now filled with snow. Mount Rainier, or Tacoma, presents, however, the double phenomena of blowing hot and cold at the same time. The upper 5,000 feet of its surface is almost a continuous sheet of ice, but through a small orifice in a portion of the crater which crowns the summit, volcanic steam continues to find vent, and furnishes heat for the unlucky explorer who is compelled to spend a night at that lofty elevation.

"The most definite account of what may be called an historically recent volcanic eruption of any considerable extent in the region referred to at the outset has just been published in a Bulletin of the United States Geological Survey, by Mr. J. S. Diller. The area described is in northern California, in the vicinity of Lassen Peak, about one hundred miles southeast of Mount Shasta. Lassen Peak is itself a vast volcanic cone, and the center of numerous others smaller in size and later in origin, but all of recent geological age. The Cinder Cone, which was the special subject of Mr. Diller's researches, is ten miles northeast of Lassen Peak, in the vicinity of Snag Lake. The general elevation is here a little over 6,000 feet above the sea, and his cone rises 640 feet above the lowest point of its base, having a diameter of 2,000 feet at the bottom, and 750 feet at the top, and is composed of cinders which readily yield and slide down under one's weight as he walks over them.

"This Cinder Cone belongs to the earliest part of the eruption, and, in Mr. Diller's opinion, cannot be much more than two hundred years old. At the same time with the explosive eruption that produced the Cinder Cone, an immense amount of volcanic sand was ejected and scattered about the base for a distance of eight miles in every direction. Near the base this is between six and seven feet in depth, and thins out gradually toward the margin. Some time subsequent to this explosive outburst there took place a quiet flow of basalt, which poured from the southeast side of the cone, and spread itself over the sand, covering an area about three miles long by a little over a mile in width. The edge of this flow everywhere presents a precipitous front about one hundred feet in height, and Snag Lake is formed by the dam which this basalt stream has extended across the valley into which it flowed.

"The data for determining the age of this eruption seem to be as conclusive as could be desired. Dead pine trees, with their roots in the original soil, can still be seen projecting above the volcanic sand of the first eruption, and in some instances they have been partially overwhelmed by the later eruption of basalt, and their decaying tops project from under it. But the living trees all grow upon the surface of volcanic sand, and near the base of the cone their roots are not long enough to reach the original soil. The age of the oldest of the trees found living does not exceed two hundred years, and that, doubtless, as Mr. Diller supposes, very closely marks the date of the earlier eruption. Ordinarily, also, pine trees, overwhelmed as this original forest was, would not survive more than thirty years. In the conditions of this dry climate two hundred years is a long time for them to remain exposed to the air without complete decay.

"The demonstration of so much volcanic activity at so recent a date in California renders it altogether likely that other eruptions will occur in that region in process of time, and that others have occurred at no great distance in the past. Previous to the eruption of the year 79, there was no historic record that Vesuvius had been an active volcano, and at a later period—between the fourteenth and seventeenth centuries—more than three hundred years elapsed without any serious eruption. It will be a matter of surprise if the volcanic forces west of the Rocky Mountains do not yet assert themselves with greater or less vigor. These investigations of Mr. Diller, therefore, show the possibility of bringing down to a reasonably modern period the date of the remains of man which have been found under the lava in various places on the Pacific Coast.

"Even Table Mountain in California might seem to yield a modern chronology in view of one fact brought out by Mr. Diller. It has been supposed that all of the erosion of the deeper valleys about Table Mountain has been subsequent to the time when this lava stream filled up the old channel of the Stanislaus River. In the light of Mr. Diller's observations, however, it would seem possible to suppose that the Table Mountain lava flow did not always follow the lowest channels open to it, but that it may have built up for itself obstructions in front of which it might turn aside to occupy abandoned channels of the old river at a higher level. This, at any rate, was a theory which suggested itself to me a year ago, as I examined the country about ten miles above Sonora, where the Table Mountain stream of lava crosses to the left side of the present Stanislaus. That the theory suggested to my mind in reference to the Table Mountain flow might have been a fact would seem no more strange than the actual course of some of the streams of lava which Mr. Diller has traced from the Cinder Cone so carefully studied by him. He says: 'At first the main stream flowed to the southeast, but gradually turned around to the left, until its direction was slightly west of north, where, though having flowed a total distance of three miles, the cessation of its flow was not more than a mile and a half from the vent. This course was not determined by the original configuration of the land, but by the obstructions to the later streams furnished by the cooling of earlier streams.'

"In view of present activity in the discussions of the antiquity of man, I can but regard this publication of Mr. Diller as of the very highest importance as calculated to allay the fears of a certain portion of the Christian public, and to check the hasty inferences that some are likely to draw from the recent facts which have been so freely published concerning the relation of man to the lava beds of the Pacific Coast. The time has not yet come to give the full chronological significance to those facts."

Continental Problems.—The annual address of Mr. G. K. Gilbert, President of the Geological Society of America, consisted of a statement of six unsolved continental problems, with a discussion of each question in turn. (1) "How are Continents supported?" introduced the doctrine of Rigidity versus Isostasy, with the weight of evidence in favor of the latter doctrine. (2) "Does heat or composition determine the difference in density of the material of the earth's crust?" was discussed in connection with (3) "What caused the Continental Plateau?" in which the author spoke at length of the only hypothesis yet advanced, that of Mr. Dana, which deserves to be more fully compared with the body of modern data. (4) "Why do Continental Areas rise and fall?" is a problem for which no solution has been suggested. (5) "Are Continents Permanent?" may probably be answered in the affirmative, but the fact is not yet fully established. (6) "Do Continents Grow?" is still open to discussion, although the doctrine has been generally accepted. In the author's opinion, the greater part of the data from which continental growth has been inferred may be fictitious and misleading. (Bull. Geol. Soc. Am., Vol. IV, 1893.)

Mineral Resources of the United States for 1891.[1]—This volume is the eighth of a series begun in 1882. It deals with the mineral progress of the year 1891, and contains a complete statement of the mineral products of that year. The opening chapter is a summary of the quantity and value of the metallic and non-metallic products for 1891, and also contains tabular statements of the outputs from 1880 to 1891. Under the head of Iron Ores, a résumé of the progress in the manufacture of iron and steel in the United States for the past twenty years is given.

The names of the contributors of the various sections appear in connection with the subjects treated.

[1] Mineral Resources of the United States for the Calendar Year 1891. David S. Day, Chief of Division of Mining Statistics and Technology. Washington, 1893.

Note on an Upper Devonian Fish from Canada.—A collection of fishes made by Mr. Jex at Campbelltown and Scaumenac Bay, Canada, has been recently examined by Dr. R. H. Traquair. Among them is a fine series of *Phaneropleuron curtum* Whiteaves, which shows clearly that the short break in the dorsal fin, which Whiteaves figured, but thought might be an accidental or abnormal character, is a natural division, and that the dorsal fin is in two distinct portions. Dr. Traquair feels justified in erecting the Whiteaves species into a new genus characterized by its double dorsal fin, and proposes for it the name *Scaumenacia curta*. (Geol. Mag., June, 1893.)

The Diatomaceæ of the Triassic (?) sandstone of New Jersey.—When I first settled in Newark, New Jersey, twenty years ago, I went about looking at the red sandstone for Diatomaceæ in it; but did not find them. I found pieces of trunks of wood. I found carbonate, silicate and sulphide of copper and carbonate of lime and mica, and worm burrows and ripple marks but nothing else. No minute fossils like Diatomaceæ. I looked at the sandstone every now and then, reasoning that it was a fresh water sediment, most likely laid down in very shallow water, and must contain the remains of Diatomaceæ, if they existed then. I examined the sandstone at Glen Ridge, about two miles from the station at Bloomfield on the Montclair and Bloomfield branch railroad where the Glen Ridge quarry and mining company have a quarry and are mining for copper. I examined the white sandstone at Forest Hill on the Greenwood Lake railroad and the old Schuyler copper mines at Belleville. I visited the red sandstone in the cutting where the Greenwood Lake railroad came through at Arlington just above Newark on the Passaic river. The cut is deep and it shows the sandstone dipping to the northwest and also a fissure which parted the rock in a nearly north and south direction or parallel to their strike. It is about five feet wide and shows rounded pieces of trap. This strongly indicates that the trap is not far below and that heat partially metamorphosed the rocks. This is one of the few fissures in the Triassic. The shale shows worm burrows and ripple marks. This would seem to point to a later instrusion than the Triassic of the trap. I examined the shale with acids for Diatomaceæ but without success. At last in June of this year, 1893, I found a spot immediately on the Passaic river just south of the city of Passaic where L. H. Arden has a brick yard in operation. I found he mined the clay from which the brick was made close by, and I visited the clay pit and saw the clay in finely stratified layers about as thin as paper and extending to about twelve feet upward from the rain water which had accumulated here, on the day I saw it. The clay was red or brown and rather poor and the layers looking like a heap of reddish paper with darker papers introduced every now and then. On the top of this was about two feet of red glacial gravel in the form of till and between the gravel and the clay was a pocket of yellow clay which evidently belonged to the glacial deposit which I have examined all over northern New Jersey and which forms the so-called Lacustrine, Sedimentary or Sub Peat deposits of Diatomaceæ which occur from Nova Scotia to Pennsylvania on the Atlantic coast of the United States. This stratified clay is Triassic and I examined it with considerable interest for it was formed in shallow fresh water, and contained Diatomaceæ, scarce it is true, but the first Diatomacæ geologically speaking that have been found anywhere on the globe if we except the Diatomaceæ of the Carboniferous Coal found by Count Castracane some years ago. But the coal in which he discovered Diatomaceæ is doubtfully carboniferous. Perhaps it may be Tertiary. The Diatomaceæ I found in the Triassic clay were *Gomphonema acuminatum* and *Brebissonia lanceolata* along with straight sponge spicules. The clay was Triassic beyond a doubt for it was under the glacial clay and glacial till. What it rested upon is doubtful, Triassic sandstone most likely, for Triassic sandstone covers this part of New Jersey and no other rock is seen. It is important to note the finding of Triassic Diatomaceæ at this time and perhaps they will be seen in quantity further on. The color of the Triassic sandstone due to red iron oxide is remarkable and deserves investigation. The same color is present in the Catskill sandstone and at first they could be classed as one, but of course the fossils are different, and are very scarce in the Triassic, and rather plenty in the Catskill. It can hardly come from the magnetite on the border of the sandstone, as I. C. Russell suggests, for that, although present in New Jersey, is not always present and cannot be the cause of the red color of the Catskill sandstone. Perhaps it is present as an iron silicate, for it is more difficult to dissolve by boiling in acids than simple iron oxide.

ARTHUR M. EDWARDS, M. D.

Do Glaciers Excavate?—The recent critical examination of Alpine and other mountain valleys by Professor T. G. Bonney, confirms the conclusion he reached in 1874, that these valleys appear to be much older than the ice age, and to have been but little-modified during the period or maximum extension of the glaciers. Mr. Bonney asserts that the erosive power of glaciers is small—quite unequal to the work which has been ascribed to it. In this connection the author considers the difficulties presented by certain Alpine lakes in attributing them to the erosive action of glaciers. The position of such lakes as Constance, Geneva, Como, etc., and the subaqueous contours of Como and Geneva militate against the glacial erosion theory. The hypothesis offered by Mr. Bonney as an explanation of these lake basins is that originally they were eroded by ordinary agencies, and that their beds have been subsequently affected by differential movements. He instances as an example bearing out his theory the Great Lakes of North America whose origin has been so ably demonstrated by Dr. J. W. Spencer. (Geog. Journ., June, 1893.)

Plistocene Deposits of Russia.—Mr. S. Nikitin has given a brief account of the Quaternary deposits of Russia in a pamphlet of thirty-four large octavo pages. It is, however, merely a summary of a more detailed report which he is soon to publish. The paper closes with the following statement of the principal theses:

1. "The sub-division of the stone age into paleolithic and neolithic epochs should be preserved for European Russia, because it here coincides with the geological divisions into Pleistocene and modern, which are, in their turn, based upon paleontological data.

2. "The study of the glacial deposits of Finland and of the western region furnishes no proof of the existence of two distinct glacial epochs and an inter-glacial epoch. All the facts can be explained by the phenomena of the oscillation of the glacier at the time of its gradual, but irregular, retreat.

3. "If, however, one accepts the Swedish and Prussian theory of the sub-division of the glacial period into two epochs and an interglacial epoch, the second glaciation cannot have extended beyond the western region, in a certain part (comparatively restricted) of the Baltic region of Finland and of the government of Olonetz.

4. "The other portion of Russia subjected to glaciation, has only one morainic stage, corresponding to the deposits of the first glacial epoch of the Swedes.

5. "At the epoch of the more extended glaciation, the major part of Russia presented the aspect of a desert of ice, similar to that of Greenland, carrying no moraine upon its surface, and presenting no elevation free from ice, where forest vegetation could be preserved.

6. "The time corresponding to the interglacial epoch and the second glaciation of the Swedes, was probably, for the greater part of Russia, the epoch of the formation of the ancient lake deposits, the loess, and

the upper terraces of the rivers, which constitute the principal repository for the bones of the mammoth and other extinct mammals, which abounded here while Scandinavia and Finland were still covered by the glacier.

7. "In accordance with the composition and genesis of her Quaternary deposits, European Russia may be divided into a series of typical regions which are very characteristic, although resting upon differences which are scarcely recognizable, but which illustrate none the less the life of the immense Russian plain during the Quaternary period, and the formation of her superficial deposits.

8. "In the second portion of the glacial epoch, or of the pleistocene, the mammoth and other large mammals inhabited southern and eastern Russia in great numbers. As the glacier retreated, these animals advanced toward the north and northwest; toward the close of the pleistocene they reached Finland for a short time, and then disappeared entirely throughout the whole extent of European Russia, but probably later in the northeastern part and in Siberia.

9. "Man lived contemporaneously with the mammoth during the second part of the glacial epoch along the limits of glaciation, possessing an industry well-advanced, making use of fire among other things, but producing implements solely of naked flint. As the glacier retired, man advanced toward the north and northwest; he arrived in Finland and the Baltic region after the close of glaciation and after the disappearance of the mammoth; but man himself possessed already the more advanced culture of the neolithic age, and besides implements of trimmed flint, he knew how to make implements in polished stone, pottery, etc.

10. "European Russia shows no traces of man in the first part of the Pleistocene, or of any more ancient man." (Am. Journ. Sci., June, 1893.)

BOTANY.

Check-List of New North American Plants.—The botanical publications of the Department of Agriculture at Washington are becoming year by year of more scientific value, and at the same time more useful. Botanists have come to look upon the "Contributions from the U. S. National Herbarium" as real contributions which they are glad to receive, and in which they may feel a just pride. The last number (No. 7) consists of a "Systematic and Alphabetic Index to New Species of North American Phanerogams and Pteridophytes, published in 1892," prepared by Miss Josephine A. Clark. Appearing the middle of July, it is refreshingly recent, and makes us hope that under the energetic management of Chief Coville this will be the rule with publications from his division.

The list is much like the one published last year (Sept. 20, 1892), and as then described, it is based upon the card index of new species and new combinations, made primarily for the use of the Botanical Division. Its usefulness there, suggested to Dr. Vasey its publication for the benefit of botanists throughout the country.

A marked improvement which we notice with great pleasure is the uniform decapitalization of all specific names, and the omission of the comma before the name of the author. We trust that this will hereafter be the rule in the National Herbarium.

CHARLES E. BESSEY.

Shall we Decapitalize Specific Names ?—By the time that this is in print, the Botanical Club of the A. A. A. S. will have discussed and perhaps decided this question; but we wish here to record before this anticipated action, our conviction that it is but a question of time when decapitalization will be the rule. It is to be hoped that the Club will decide in favor of it now, but if it does not, it will but defer the matter a few years. The revulsion against the over-capitalization of DeCandolle, Gray and Watson may not now be strong enough to demand absolute decapitalization ; it may be satisfied with retaining the capital initial for genitives of personal names, and possibly for old substantives. This would be a great improvement, inasmuch as it would require the decapitalization of nearly one-half of the names now capitalized in the new edition of Gray's Manual.

Of course, every one knows that grammatically the argument is a pretty strong one in favor of a partial capitalization, but something may be said on the other side, even on this ground. Primarily the specific name is a limiting or qualifying term, that is, it has an adjectival function, and as such it is properly written with the small initial letter. There should be no question as to such cases as *virginiana, coroliniana, pennsylvanica*, etc. Linne himself wrote them with the small initial letter, as also Willdenow and Sprengel. Why then should there be any hesitancy in writing *oakesiana, purshiana, kalmianum*, etc.? Even in Gray's Manual we have *sambucifolia, alnifolia, hyssopifolius, nepetæfolia*, and, most astonishing of all, *fossombronioides*. Why the Italian Fossombroni should be decapitalized here, it will puzzle any advocate of capitalization to explain.

Nothing is gained by capitalizing, and it requires some extra effort to remember whether to use the capital or not, while by decapitalizing we gain much in appearance of the printed page, and save appreciably in time and the effort to remember a complicated rule.

CHARLES E. BESSEY.

The Use of Personal Names in Designating Species.[1]—The first sentence of the thirty-second article of the Paris Code is as follows: "The specific name ought, in general, to indicate something of the appearance, the characters, the origin, the history or the properties of the species." The twenty-seventh section of the rules of nomenclature adopted in 1877 by the zoologists of the American Association for the Advancement of Science (with the advice of Dr. Gray, and other botanists) is almost identical with the foregoing: "The specific name should, in general, indicate some feature of the appearance, characters, origin, history or properties of the species." The purpose of the rule cited is, without question, to favor the adoption of names which have some real significance, and when we look over the work of the great masters in descriptive botany we see how fully they followed its spirit. In the first and third editions of Linne's "Species Plantarum" nearly all the specific names are in some degree, descriptive. One finds names as follows (pp. 118–119) *suecica, canadensis, tomentosa, trifoliata, viscosa, alternifolia, perennis, uniflora, biflora, umbellata, corymbosa, latifolia*, etc. If we compare Linne's practice with that of recent descriptive botanists we find a great change in the frequency with which personal names are used. In the first two hundred pages of Vol. I, of the first edition of the "Species Plantarum," including about one thousand species, there are not to exceed seven such names, viz: *michelianus*, *lœflingiana*, *halleri*, *matthioli*, *Gmeleni*, *monelli*, and *Osbeckii*, (notice in passing, the capitalization, which is still maintained in the third edition). Here we have less than one per cent of names derived from personal names, which is in striking contrast with what we find in recent lists.

---

[1] Read before the Botanical Club of the A. A. A. S., August 21, 1893.

In the list of New Species of North American Phanerogams and Pteridophytes, published in 1891, issued by the U. S. National Herbarium, *twenty-three per cent* of the specific names are derived from personal names. In the similar list for 1892 we find a little more than 18 per cent. of such names. Taking the two years together, the personal names are exactly twenty-one per cent. of the whole. Has not this thrusting forward of personal names gone entirely too far? It certainly violates every principle of good taste. Botanists may soon be properly charged by other scientific men with showing an over-eagerness to gain the petty notoriety which attaches to having one's name borne by some plant. There should be a speedy reform in this practice.

It is a proper thing to construct a euphonious name from the name of an eminent botanist, and apply it to a new genus. There is some dignity in such a procedure; but there is a great deal of difference between the dedication of a genus to a great man, and the other practice of assigning new species to every collector,—*because the collectors like it!*

CHARLES E. BESSEY.

Botany at the Madison Meetings.—The most notable gathering of American botanists in recent times took place in August of the present year in connection with the forty-second meeting of the American Association for the Advancement of Science, and the several affiliated societies. Especial efforts had been made to secure a large attendance, which was successful beyond the most sanguine expectations. But few of the more active of our botanists were absent, and these were unavoidably detained.

This being the first year of the existence of a separate section (G) of botany, all members of the Association watched the experiment with much interest. But when the permanent secretary announced in the closing general session that the new section had received *one-fifth* of all the papers presented to the Association, all doubts as to the ability of the botanists to maintain a separate section disappeared.

The session opened on Thursday, August 17, with the address of the Vice-President on "Evolution and Classification," the burden of which was that in the present classification, of the higher plants especially, the facts of evolution are practically ignored.

On Friday papers as follows were read:

G. F. ATKINSON, Photography as a means for recording the macroscopic characters of micro-organisms in artificial cultures. The author detailed his method of securing good photographs by means of oblique light in connection with a black card interposed between the object and the source of light.

G. F. ATKINSON, Symbiosis in the roots of Ophioglosseæ. A fungus appears to be present in the cortical tissues of the roots of all the species examined.

B. T. GALLOWAY, Observations on a rust affecting the leaves of the Jersey or Scrub Pine. This was a discussion of the structure of the normal and diseased leaves, and an account of the mode of infection by the parasite, *Coleosporium pini.*

W. J. BEAL, Prophylla of Gramineæ. Illustrated by drawings and sketches.

CHARLES R. BARNES, On the food of green plants. This was one of the most carefully written papers presented during the meetings. The author proposed a sharper separation of the operations concerned in the nutrition of plants, as follows: (1) *Photosyntax,* for the fixation of carbon by chlororphyll; (2) *Digestion* and (3) *Assimilation.* The publication of this paper will be looked for with interest.

J. CHRISTIAN BAY, A new infection needle for the study of lower plants. Illustrated by sketches and examples.

G. F. ATKINSON, Comparative study of the structure and function of the sporangia of ferns in the dispersion of spores. Illustrated by a number of large drawings.

BYRON D. HALSTED, The Solandi printing applied to botanical work. By the use of sensitive photographer's paper the author is able to obtain fine negatives directly from leaves, and from these he prints very useful photographs. Many specimens of this process were shown.

N. L. BRITTON, Present aspects of the nomenclature question. Analyzing the subject as it presents itself to-day. There are (1) the pre-Linnæans, who would go back in nomenclature to authors earlier than Linné; (2) those who would begin with the Systema Naturæ of Linné, 1735; (3) those who would begin with Linné's Genera Plantarum, 1737; and (4) those who with most botanists would begin with Linné's Species Plantarum, 1753. To these may be added (5) a few who would select a date still more recent.

T. A. Williams, Lichens of the Black Hills. Eighty-three species and varieties are known, many of which are northern and western.

J. Christian Bay, The bibliography of American botanical literature. The author made a plea for the beginning of such work.

Douglas H. Campbell, Notes on the development of *Marattia douglasii*. Describing the prothallia, and suggesting a relationship with certain Hepaticæ.

On Monday papers were read as follows:

Theobald Smith, Further observations on the fermentation-tube, with special reference to anærobiosis, reduction, and gas production. Illustrated by the apparatus used by the author.

John G. Jack, The fructification of *Juniperus*. The author finds that the fruits of *J. virginiana* ripen the first season, while in *J. sabina* var. *procumbens* it requires two seasons, and in *J. communis*, three seasons.

S. G. Wright, The minute structure and development of the motile organ in the leaf of the Red-bud. This was an anatomical and physiological paper.

Erwin F. Smith, Two new and distinctive diseases of Cucurbits. Describing an *Alternaria* on melons, and another on cucumbers and cantaloupes due to bacteria.

Conway McMillan, Preliminary statement concerning botanical laboratories and instruction in American universities and colleges. This paper was considered so important that the Association requested the Commissioner of Education at Washington to print it as one of the educational bulletins. Incidentally, it appears that many colleges are still giving *as college work*, short spring term courses in Gray's "Lessons!!"

The reading of this paper resulted in the appointment of a committee consisting of Drs. Coulter, Campbell and Britton, to inquire into the teaching of botany in the secondary schools of the United States.

Byron D. Halsted, The shrinkage of leaves in drying. By means of photographs by the "Solandi" process, it was shown that the shrinkage is often considerable.

M. B. Thomas, The roots of orchids.

L. H. Pammel, Preliminary notes on some chromogenic bacteria of the Ames flora.

B. T. Galloway, Results of some recent work on rust of wheat.

J. H. Pillsbury, On the quantitive analysis of the colors of flowers and foliage.

For want of time the four last named were read by title.

On Tuesday the following papers were read.

S. M. Tracy, Distribution of the Gramineæ in the United States. Illustrated by many maps.

N. L. Britton, A consideration of species based upon the theory of evolution. An attempt to formulate our present ideas of species.

Elizabeth G. Britton, A revision of the genus *Physcomitrium*. Showing that while we supposed that we had half a dozen species, it appears that we have nearly or quite double that number.

W. T. Swingle, On *Cephaluros mycoidea* and *Phyllosiphon* sp., two parasitic algæ new to North America. These curious plants, the first of which lives upon Magnolia leaves and the latter upon the leaves of *Arisœma*, appear to be truly parasitic.

Frederick V. Coville, An analysis of the conditions affecting the distribution of plants. These were given as temperature, light, food, water and mechanique.

J. C. Arthur, Deviation in development due to the use of unripe seeds. As this paper will be published in full in the Naturalist, no summary will now be attempted.

W. T. Swingle, The principal diseases of citrous fruits now being studied at Eustis, Fla. Illustrated by specimens of fresh material.

P. H. Rolfs, A sclerotium disease of plants. Giving details of the structure.

Elizabeth G. Britton, *Ulota americana* Mitten and *Orthotrichum americanum* Beauv. The author discussed fully the question of their identity, which appears to be established.

The following were read by title for want of time:

L. H. Pammel, Notes on *Rœstelia pyrata*, Crossing of Cucurbits and A case of poisoning by the wild parsnip, *Cicuta maculata*, (three papers).

The Botanical Club held sessions on Friday, Monday and Tuesday. It received the report of the committee appointed last year to prepare a check list of North American phanerogams, and after much dicussion, provision was made for printing it. In this connection, Rule III of the "Rochester Code," was modified so as to allow the use of a specific name identical with the generic. The rule now reads as follows:

"In the transfer of a species to a genus other than the one under which it was first published the original specific name is to be retained."

Another important action of the club was that relating to the proposed American botanical society. A committee of ten was elected and empowered to increase its number to twenty-five, to organize such a society. The following is the committee: J. C. Arthur, G. F.

Atkinson, C. R. Barnes, C. E. Bessey, L. H. Bailey, N. L. Britton, Mrs. E. G. Britton, J. M. Coulter, F. V. Coville, D. H. Campbell, D. C. Eaton, W. G. Farlow, E. L. Greene, B. D. Halsted, Arthur Hollick, C. MacMillan, B. L. Robinson, F. L. Scribner, C. L. Sargent, J. D. Smith, Wm. Trelease, R. Thaxter, L. M. Underwood, L. F. Ward, W. P. Wilson.

Papers were read in the club, many of them of much importance.

On Saturday the Club accompanied the Association to the Dells of the Wisconsin River, and spent a day in collecting and in the enjoyment of the beautiful scenery, with much of social pleasure.

An American botanical society is now assured. The committee to effect an organization met promptly and made preliminary arrangements for a meeting next year in connection with the Association. A sub-committee consisting of Messrs Trelease, Coulter, Bailey, MacMillan and Sargent, was appointed to attend to the details of permanent organization.

The Botanical Congress which had been called by the committee appointed for the purpose, convened at 10 o'clock, A. M., August 23, with 37 members. Since, for various reasons, but few foreign botanists were able to attend, the name adopted was the "Madison Botanical Congress." Dr. E. L- Greene of California was elected President and Henri de Vilmorin of France, and L. M. Underwood of Indiana, Vice-Presidents. J. C. Arthur of Indiana, B. L. Robinson of Massachusetts, and F. V. Coville of the District of Columbia, Secretaries. C. R. Barnes of Wisconsin was elected Treasurer.

Committee reports were received, as follows:

On the Nomenclature of Plant Diseases. After discussion this was referred to an enlarged committee, of which Dr. B. D. Halsted of New Jersey is chairman, with instructions to report in 1894 to Section G of the American Association for the Advancement of Science.

On the terminology of Vegetable Physiology; suggesting greater precision in the use of terms. This was likewise referred to a committee, with Dr. J. C. Arthur of Indiana as chairman, to report to Section G in 1894.

On the terminology of Anatomy and Morphology. After discussion a committee of five, with Dr. D. H. Campbell of California as chairman, was appointed to report in 1894 to Section G.

On the Nomenclature of Horticultural forms; recommending for the present the use of Nicholson's "Dictionary of Gardening," supplemented by the "Index Kewensis," for scientific names. This report was adopted.

On the Bibliography of North American Botany; urging the necessity of the early inauguration of bibliographic work, and suggesting rules for uniform methods of citation. The congress voted affirmatively upon the first proposition, and then referred it to a committee with Dr. C. R. Barnes of Wisconsin as chairman. The rules as to methods of citation were agreed to, and will be printed in the proceedings of the congress.

On the terminology of Geographical Botany. After short discussion this was referred to a committee with F. V. Coville of the District of Columbia as chairman.

Appropriate resolutions were presented and adopted regarding the death of Alphonse de Candolle, and George Vasey.

Resolutions were adopted respecting the condition of the United States National Herbarium, at present deposited in a building in Washington which from its construction and use is liable to destruction by fire, and the United States Congress was memorialized to make early provision for a fire-proof building for the preservation of this scientific treasure. The Secretary of Agriculture was respectfully requested to urge prompt action in this matter.

The thanks of the Congress were extended to Dr. Otto Kuntze for valuable printed papers presented by him for the use of the members.

On Wednesnay afternoon open invitation of the local committee of arrangements the members of the Congress took part in a botanical excursion to Lake Wingra, and after adjournment (Thursday, 5 P. M.), all enjoyed a two hours' moonlight ride upon Lake Mendota.

There is no space in this account for a full notice of the botanical papers read in the Society for the Promotion of Agricultural Science. The Secretary, Dr. Frear, communicates the following titles:

W. J. BEAL. Methods of killing Couch- or Quack-Grass.
W. J. BEAL. Some Grass Mixtures for lawns.
W. R. LAZENBY. Sub-irrigation for Green-house and Garden.
C. E. BESSEY. The Weeds of Nebraska.
B. D. HALSTED. Potatoes by the direct method.
G. F. ATKINSON. A new fungus disease of the Apple.
B. T. GALLOWAY. The Macrosporium disease of potatoes.
J. C. ARTHUR. A new factor in improving farm crops.

These will be published in the proceedings of the Society.

The attendance of working botanists was unusually large at all the meetings in Madison. Many men whose faces are rarely seen were present, some for the first time in their lives. A few of the active botanists of the country who have usually taken part in such meetngs were missed, while on the other hand, the older members were made aware of the fact that there is a rapidly growing group of younger men who are pushing their way to the front by their good work.—CHARLES E. BESSEY.

ZOOLOGY.

Classification of the Actiniæ.—In his account[1] of the Actiniæ of the "Albatross" collections of 1887–88, Professor J. P. McMurrich gives first a historical résumé of the growth of our knowledge of the Actinians and then presents his own ideas of the limits and arrangement of the families, followed by a description of the forms collected by the "Albatross." In the historical part we notice that the separation of the Bryozoa (better Polyzoa) from the Cœlenterates is credited to Milne Edwards. We had always understood that the discovery was made by J. Vaughan Thompson in 1830.

Changing the typographical arrangement Professor McMurrich gives the following classification of the Hexactinians.

- A. Tentacles arranged in cycles ACTINIÆ.
  - *a*. Column simple
    - 1. Tentacles cylindrical, smooth.
      - * Sphincter absent or weak, entodermal.
        - † Mesenteries not numerous. Halcampidæ.
        - † † Mesenteries numerous. Antheidæ.
      - * * Sphincter entodermal, tentacles deciduous. Boloceridæ.
      - * * * Sphincter mesoglœal.
        - † No acontia. Paractidæ.
        - † † Acontia. Sagartidæ.
      - * * * * Sphincter entodermal, circumscribed.
        - † Acrorhagi wart-like. Bunodidæ.
        - † † Acrorhagi foliate. Phyllactidæ.
    - 2. Tentacles warty or branched.
      - * Tentacles simple. Heteractidæ.
      - * * Tentacles compound. Thalassianthidæ.
    - 3. Tentacles reduced to stomidia. { Polyopidæ. Sicyonidæ.
  - *b*. Column provided in its upper part with branched or globular processes. Dendromelidæ.
  - *c*. Free swimming forms. Minyidæ.
- B. Tentacles arranged radially STICHODACLYHINÆ.
  - *a*. Tentacles all of one form.
    - 1. Tentacles few, capitate Corallimorphidæ.
    - 2. Tentacles numerous, cylindrical. Discosomidæ.

---

[1] Proc. Nat. Mus., XV., p. 119, 1893.

3. Tentacles nodulated. Aurelianidæ.

b. Tentacles of two forms.

1. Marginal tentacles cylindrical; disc tentacles wart-like, branched or foliate. Rhododactidæ.
2. Marginal tentacles pinnate; disc tentacles wart-like. Phymanthidæ.

c. Tentacles of various forms, not cylindrical. Cryptopdendridæ.

It is a pity that the Government cannot provide good illustrations for papers like this, but like all the publications of the Fish Commission it has put up with unsatisfactory photo-cuts.

Maioid Crabs in the National Museum.—Miss Mary J. Rathbun continues[2] her studies of the Maioid Crabs by an account of the species of the family Maiidæ in the National Museum. She enumerates 39 species as occurring in the collection and gives a list of desiderata which includes 100 species. The new forms described are *Chionœcetes tannerii, Cœlocerus grandis, Lepteces* (n. g.) *ornatus and Hyastenus caribbœus.* The paper concludes with an extract from the as yet unpublished MSS. of the late Dr. Stimpson, a part of his final report upon the Crustacea of the Ringold and Rodgers Expedition to the North Pacific. The value of this last would have been increased by including references to the preliminary report on the same expedition published in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1857.

A New Lancelet.[3]—Dr. E. A. Andrews regard the small lancelet which was found by the Johns Hopkins Marine Station in the Bahamas as the type of a distinct genus of Acraniata to which he has given the name *Asymmetron lucayanum.* The chief anatomical peculiarities of the form are found in the asymmetrical character of the reproductive organs, which occur on the right side of the body alone, in the absence of fin-rays from the ventral fin and in the presence of a long caudal process extending posterior to the last myotome. Dr. Andrews has also collected the literature of the various species of Amphioxus from which we learn that the following species have been described from the world.

Branchiostoma lanceolatum: Scandinavia, England, Mediterranean, Chesapeake Bay? Fiji Island?

B. caribœum: Mouth of La Plata, Brazil, St. Thomas, Jamaica,

---

[2] Proc. Nat. Mus., XVI, p. 63, 1893.

[3] Studies from Biol. Laby., Johns Hopkins, V, 1893.

Tampa Bay, Gulf of Mexico, Beufort, N. C.
B. cultellum: Australia.
B. bassanum: Australia.
B. belcheri: Australia.
B. elongatum: Peru.
B. californiense: California.
Asymmetron lucayanum: Bahamas.

Besides these, specimens have been reported from Japan, Ceylon, and the Bermudas. It is possible that the *B. cultellum* of the above list may prove to be a species of Asymmetron. Peters genus Epigonichthys is apparently regarded as synonymous with Branchiostoma.

Descriptions of Four New Rodents from California.—During the past year I have received among other mammals a considerable series of Californian rodents of the genera Sitomys, Reithrodontomys and Onychomys. In the identification of these it was found necessary to determine, if possible, the status of certain Californian forms described by Professor Baird in 1857, more especially of his *Hesperomys eremicus, H. boylii, H. gambelii* and *H. austerus.* The results of this study were necessarily incomplete, and, though far from satisfactory, some points of importance seemed sufficiently proven to warrant publication, and a paper was in preparation and nearly ready for the printer when Dr. J. A. Allen's Article on a collection of mammals from the San Pedro Martir region of Lower California came out in the Bulletin of the American Museum of Natural History.

This covered so exactly much of the same ground gone over by my own investigations in so much more exhaustive a manner and with such similar results, the original scope of this paper has been materially changed.

Among the series lately received by me from collectors in southern California there are four forms apparently undescribed. In determining the status of these I am greatly indebted to Dr. J. A. Allen for the loan of specimens from the New York Museum of Natural History, and for the critical examination of some of my own, forming the basis of this paper.

For the loan of the type specimen of *Onychomys torridus* and a large series of rodents from southern California, thanks are due to Mr. F. W. True of the National Museum, and Mr. Gerrit S. Miller, Jr., of Peterboro, New York.

1. *Sitomys major* Sp. nov. (Type No. 1202, ♂; Col. of S. N. Rhoads, Squirrel Inn, San Bernardino Co., July 1, 1893; col. by R. B. Herron).

Description.—Size large, somewhat less than largest *S. californicus*. Tail about length of head and body, stout, and scantily covered with coarse hairs; terminal pencil inappreciable. Hind feet smaller than in *californicus*. Ears large, more rounded and thinly-haired than in *californicus*. Color pale, grayish buff on upper parts, becoming brownish on rump and lacking any darker dorsal stripe. Sides, from eyes to root of tail, more buffy than upper parts, but no definite lateral stripe. Lower parts uniform grayish white, lacking buffy or plumbeous tints on throat and ventral region always present in *californicus*. A narrow, black, ring encircles each eye.

Measurements.[1]—Total length, 193.5; tail, 98.5; hind foot, 22.5. Skull—total length, 28.5; basilar length, 20.5; zygomatic breadth, 13.8; length of nasals, 10.5; interorbital constriction, 4.3.

Another specimen, a female, taken at the same date and place, has lost half the tail during life. In no other respect does she differ from the type, the length of the head and body and of the feet being the same in both.

In size, form, dentition and relative measurements the skull of *major* differs inappreciably from its near ally, *californicus*. The resemblance of *major* to Baird's description of "*Hesperomys boylii*" and its apparent affinities with *californicus* inclined me to the belief that it was his "Long-tailed Mouse," and that it should be classed a sub-species of *californicus* as *S. californicus boylii*. Dr. Allen, who has examined the type of *boylii*, and to whom I submitted the two specimens of *major* for an opinion on this question, thinks their identity very doubtful, though admitting their apparent resemblance in size and coloration; neither does he consider the relationship of *major* to *californicus* at all close. Independently of this verdict I should have hesitated to give *major* full specific rank.

I am informed that Dr. Merriam has secured a series of *Sitomys* from the type locality of *boylii* in Eldorado Co., which will enable him shortly to re-describe that species and settle a much involved question in the synonomy of this very puzzling genus.

2. *Sitomys herronii*[2] Sp. nov. (Type No. 815, ♀, Col. of S. N. Rhoads, San Bernardino Valley, Cal., March 3, 1893, col. by R. B. Herron.)

Description.—Body short and stout; ears large, very thinly and minutely haired. Tail very long and slender (one-third longer than head and body), clothed with minute, whitish hairs, slightly darker along ridge, the annuli not concealed thereby. There is no dark ring around eyes. Upper parts uniformly buffy gray, lacking any tendency to a darker median area, the lower sides and cheeks becoming purer ochraceous buff, the root of the tail being encircled by same color. The face is grayer than rest of upper parts. Pelage very soft, long and full. Feet white, small and slender, upper half of thighs and fore-legs, buff. Lower parts soiled gray washed with buff, whitest on chin, darkest on breast and belly.

---

[1] All measurements given in this paper are in millimeters, and were made by collector before skinning.

[2] For Mr. R. B. Herron, whose abilities as an expert and painstaking field-collector more than deserves public recognition.

Measurements.—Total length, 200; tail, 115; hind foot, 21. Skull—total length, 24.5; basilar length, 18.5; zygomatic breadth, 12.3; length of nasals, 9.2; interorbital construction, 3.5

This species is represented by four specimens, all taken in March, April, and June, on the ranch of the gentleman whose name they bear.

They belong to the long-and-naked-tailed, large-eared group of *Sitomys* typified by *eremicus.* In colors and general proportions the nearest ally of *herronii* is probably the *S. rowleyi*[3] of Dr. Allen, from Utah. It differs therefrom according to Dr. Allen, "in slenderer feet, buffy white instead of pure white underparts, rather grayer head and naked, instead of hairy, tail." *Herronii* also differs markedly from *rowleyi* in its skull measurements when compared with those given for the latter species by Dr. Allen. The length of nasals, given as "5.5" for *rowleyi,* is probably a typographical error. I have seen no skull of *Sitomys* in which the nasals measure less than seven millimeters, and, to judge by its other dimensions, *rowleyi* must be a large species. In its average characters *herronii* comes most closely to *Sitomys eremicus* and its sub-species *fraterculus,*[4] from both of which it may readily be distinguished by its buffy tints and larger size. Cranially, it has a broader and flatter rostrum, less recurved upper incisors and relatively much longer and wider incisive foramina than *eremicus.* There is no decided variation in size and color among the *herronii* series in my possession, the type being a fair average of the lot.

3. *Onychomys ramona*[5] Sp. nov. (Type No. 823, ♀, Col. S. N. Rhoads, San Bernardino Valley, Cal., April 11, 1893, col. by R. B. Herron).

Description.—Size somewhat larger than *O. torridus,* with larger ears. Colors similar to *O. longicauda,* but with an appreciable dorsal stripe and shorter, stout tail. Skull averaging larger or as large as *O.*

---

[3] Bull. Am. Mus. Nat. Hist., V, 76.

[4] Mr. Miller, who describes *fraterculus* as a full species, now considers it a "dark coast form of *eremicus.*"

[5] For "Ramona," "H. H." Jackson's heroine of the San Bernardino Valley.

torridus and of the same proportions, but with a relatively longer mandible and higher coronoid process.

Measurements.—Total length, 147; tail, 48; hind foot, 18; ear, from crown, 12.

I have examined the type of *torridus*, with which *ramona* shows closer affinities than with any other member of the genus. Making allowance for the facts the type was "skinned out of alcohol," and the skull is missing, it is easy to see that *torridus* is externally a very different looking mouse from *ramona*, being lighter and more unicolor above and lacking the bright vinaceous wash on the sides.

Adopting the cranial and superficial characters given for *torridus* by Dr. Merriam in North American Fauna, No. 2, the two are best distinguished as follows:

Onychomys torridus.	*Onychomys ramona.*
1. Above, uniform dull, tawny cinnamon.	1. Above, grayish vinaceous buff.
2. No darker dorsal stripe.	2. Darker grayish dorsally.
3. No black ring around eye.	3. Narrow, black ring round eye.
4. Tail with dark dorsal stripe reaching three-fourths its length.	4. Tail with dark dorsal stripe, seven-eighths to nine-tenths its length.
5. Average measurements:—length, 135; tail, 45; hind-foot, 20; ear, from crown, 10.	5. Average measurements (five adults):—length, 139; tail, 48; hind-foot, 19; ear, from crown, 13.

CRANIAL MEASUREMENTS.

	torridus	*ramona*
Basilar length (of Hensel)	18.5	19.
Greatest zygomatic breadth	12.5	12.6
" parietal "	11.4	11.5
Interorbital constriction	4.2	5.
Length of nasals	9.6	10.
Foramen-magnum to incisive foramina	12.5	13.4
Alveolar length of upper molar series	3.5	3.8
Length of mandible	13.2	15.
Height of coronoid process from angle	5.8	6.8

Up to the present time no Onychomys has been recorded from California that I am aware of. Dr. Merriam informs me a large series was taken there by the Death Valley Expedition, but owing to the delay in the publication of the second part of the report on the expedition this material was, of course, unavailable in the present connection.

The American Museum of Natural History has no specimens of Onychomys from California. Two winter specimens from Dulzura, San Diego Co., Cal., were loaned by Mr. Miller. They are unaccompanied by other data, or measurements, or skulls, and so were not included in the above diagnosis. They differ from the type of *ramona* in apparently smaller size and darker dorsal shade, in which respects they more closely resemble two October specimens of *ramona*. It may be remarked that this peculiar dorsal shading is also characteristic of the majority of Dulzura *Sitomys* and *Reithrodontomys* I have examined, as compared with the same species from San Bernardino Valley, but it is not sufficient to warrant special recognition in any case.

One half-grown and one young—adult specimen of *ramona* entirely lack the characteristic colors of upper parts in fully adult specimens, being of a uniform pale steel-gray above. The same striking difference, due to age, is very noticeable in a series of *Sitomys* and *Perognathus* taken in the same region.

4. *Reithrodontomys pallidus* Sp. nov. (Type No. $\frac{3289}{2588}$, ♀, Col. Amer. Mus. Nat. History, Santa Ysabel, Cal., March, 12, 1890, col. by F. Stephens).

Description.—Smaller and lighter colored than *R. longicaudus*. Colors of upper parts tawny or buffy gray, much lighter than that of *Mus musculus*. Median dorsal area darker than sides and face, the latter being washed with ochraceous, that color becoming purer on cheeks and lateral lines of belly. Belly white, with light plumbeous cast from exposed bases of hairs. Small ventral spot and space between fore-legs, tinged with buff. Chin and throat white. Tail of same relative length as *longicaudus*, but much more finely haired and annulated, and more slender and distinctly bicolor as in corresponding parts of body. Ears relatively larger than in *longicaudus*, lighter colored and with a fulvous spot at their anterior bases. Feet pure white.

Measurements.—Total length, 137; tail, 73; hind foot, 16. Skull—total length, 19.2; basilar length, 14.6; zygomatic breadth, 10.2; length of nasals, 7.1; interorbital constriction, 3.

Only one specimen of this mouse was secured at San Bernardino. Mr. Herron reports them very rare while *longicauda* seems to be abundant near its type locality about San Francisco.

Two specimens, kindly sent me by Dr. Allen, from Santa Ysabel, are evidently the same species. They are more fully adult than the San Bernardino specimen, and, like other San Diego County skins, are blacker above. Their external and cranial characters confirm their identity with mine as contrasted with *longicaudus.* Owing to the more typical character of Dr. Allen's specimens, I have chosen one of them for the type in preference to my own. Duplicates of *pallidus* from the San Bernardino Valley southward, will most probably confirm its good specific characters. Its alliance to *megalotis* is certainly more remote than with *longicaudus.* Its possible identity with *montanus* is very doubtful on geographical grounds alone, the latter being probably, as Dr. Allen indicates, an eastern Rocky Mountain form of *humilis.* Dr. Allen's *aztecus* from New Mexico differs from it in larger size, relatively much shorter tail, less buffy color, and in cranial proportions.

In external measurements *pallidus* is much shorter and smaller-bodied than *longicaudus* and has smaller feet. In skull measurements it shows the same diminution in length with greater relative zygomatic breadth and a blunter, less attenuated rostrum. The relative length of mandible to height of coronoid process above angle in *pallidus* is in the same direction. The coronoid process in *pallidus* is sharply hooked, in *longicaudus* it is bluntly recurved.

These features are shown in the following table:

BODY MEASUREMENTS.

	longicaudus (4 adults)	*pallidus* (3 adults)
Total length	153.	138.
Length of tail vertebræ	80.	75.
" " hind foot	18.	16.
" " ear, from crown (from skin)	10.5	11.
SKULL MEASUREMENTS.		
Basilar length (of Hensel)	15.6	14.6
Greatest zygomatic breadth	9.8	10.2
Interorbital constriction	3.	3.
Length of nasals	7.8	7.1
Total length of skull	20.5	19.2
Length of mandible	12.	11.
Height of coronoid process from angle	5.1	5.

—SAMUEL N. RHOADS.

Zoological News. Reptilia.—Dr. Stejneger describes[4] as new *Xantusia henshawi* from San Diego Co., California. It may be distinguished from the other members of the genus by the possession of two interfrontonasals; one row of superciliaries; frontoparietals in contact; an interoccipital, and a vertical pupil.

Birds.—Robert Ridgway describes[5] *Odontophorus consobrinus* from Southern Mexico. It is much like *O. guttatus*, but is often darker and lacks any buff or tawny color in the crest.

Mammals.—J. A. Allen enumerates[6] fourteen species of Thomomys including four (*Th. monticolus, aureus, fossor,* and *toltecus* which are new.)

---

[4] Proc. Nat. Mus., XVI, p. 467, 1893.

[5] Proc. Nat. Mus., XVI, p. 469, 1893.

[6] Bull. Am. Mus. Nat. His., V, p. 47, 1893.

ARCHEOLOGY AND ETHNOLOGY.[1]

Ninth International Congress of Americanists.—Huelva, Spain, Oct. 7–11, 1892.—The Congress was held in the Cloisters of the Convent of La Rabida at Palos. These had been restored in the style as when Columbus resided there during the preparation for his first voyage to America.

It was opened by an address of Senor Canovas del Castillo, the Premier of Spain. He sketched the history of America, showing the Monks of Rabida and the inhabitants of Palos were strong supporters of Columbus in the organization of his expedition.

The Bishop of Badajos made a speech referring to the fraternity existing between Spain and America. This was enthusiastically responded to by Senor Palma of Peru.

A grand ball was given at night to the members of the Congress by the Municipality of Huelva.

In the evening the U. S. Warship Bennington arrived at the Port of Huelva, having in tow the two Spanish Caravels Nina and Pinta. which had been built at Barcelona under the supervision of Lieut, Wm. McC. Little, acting for Mr. Wm. S. Curtis, Chief of the Bureau of American Republics, and intended to traverse the Ocean and Great Lakes and be exhibited at Chicago in 1893.

At the session of the 8th, the representative of British Guiana asked of the Spanish Government permission to search the archives of Seville for ancient documents concerning the Discovery of America. Senor Canovas del Castillo responded heartily in the affirmative.

M. Lucien Adam of France and Senor Fabic of Spain, the President of the Congress, spoke as to the best methods of Studying the American question.

Dr. Benk. a delegate from Austria, proposed the publication of a general map of America; indeed his proposition was but a part of the general one for a map of the entire world. Dr. Benk explained his proposition, which was that this map should be upon the universal scale of 1 to 1 million, or about 16 statute miles to the inch. This would require he said, about 936 sheets, of which the land might be shown on 769 sheets. Each sheet of the map up to 60° North Latitude would embrace 5° in each direction. The more northern sheets would embrace 10° of Longitude. It was proposed to give great attention to the physical and political characteristics and that the sea should be represented as well as the land. The rivers were to be in blue and the hills in brown. Contours to be drawn at elevations of 100, 300, 500 and 1200, and the areas enclosed therein to be tinted. The Meredian of Greenwich to be accepted for the entire map. All places in countries using the Latin alphabet to be preserved as officially spelled. Other alphabets and unwritten languages to be spelled phonetically or according to some system yet to be agreed upon. Professor Benk estimated the cost of an edition of a thousand copies which show only the land surface to be in round numbers, 1 million of dollars, and the 769 sheets, if sold at ½ dollar per sheet would produce less than 400,000 dollars, leaving the sum of 600,000 to be divided among the respective countries. The consensus of opinion was that this would be great desideratum; whether it could be accomplished or not, was in greater doubt. But Dr. Benk argued that it would be a long stride toward successful accomplishment if an international agreement could be made, by which a uniform scale could be adopted for the making of such a map. This international agreement, he says, could be agitated only before such Congresses, allowing the delegates upon their return to their respective countries to agitate the subject, and prepare either the Government or public opinion for a successful result.

---

[1] This department is edited by Thomas Wilson, Smithsonian Institution, Washington, D. C.

There was further discussion and other papers read, some of which had no very close relations to America and very small right to appear before the Congress of Americanists.

The rest of the day was taken up by the banquet and preparation for the fetes.

The King and Queen Regent arrived on the 10th, and during that and next day the city of Huelva and the town of Palos and the Convent of La Rabida were given over to the fetes.

At the Paris Congress, objection was made to going to Huelva by Dr. Brinton, and the outcome verified the wisdom of the objection. It was a magnificent Naval Review—40 warships of various Nations—display of bunting—firing of guns—shouting, cheering, banqueting, and fetes in grand style; but as a scientific or historic Congress, it made but slight progress.

The Queen gave a reception at the Hotel Colon at which about 1,000 guests attended. The Column erected at La Rabida by the Government, at an expense of about 450,000 pesatas (francs) in commemoration of Columbus was inaugurated. These were attended by everybody. The locality was, of course, in gala dress. Guns, flags, music, with the bright dresses of the women and clergy, the gay uniforms of the Civil, Military and Naval Authorities and Officers, with the decorations of the pavilion and throne-room in crimson velvet and magnificent tapestries, of which the Spanish government possesses so many specimens, conspired to make a brilliant and imposing scene.

The Secretary, Senor Juan Zaragossa, was most effective in securing subscribers to the Congress of whom he had over 2,000, though only about 200 were in attendance, and but few of these were constant at the meetings or gave attention to its business. As a fete, it was a grand success; as a congress, its benefits were few.

The Exposicion Historico-Americano.—Madrid, Spain, 1892.—The Exposition was held in a permanent building, one which was new—just completed, and is intended as the home of the National Library, the Archeological Museum, and the Galleries of Sculpture and Modern Painting. It occupies the entire square between the Paseo de Recoletos and the Calle de Serrano for two opposite sides, and upon the other, the Calles Villa Neuva and Jorge Juan. The cornerstone of this building was laid in 1866, under the reign of Isabella II, and the building was intended for the Department of the Interior. Work progressed upon it until the foundations were laid and brought to the level of the ground, when the Revolution by which Queen Isabella was dethroned, brought it to a standstill. It thus remained until 1884, when the project was again brought forward and the celebrated architect, Antonio Ruiz del Salces, presented new plans for the building as a Library and Museum.

On the 19th of January, 1887, the contract for the completion of the building was entered into with Don Juan Cruneda at the price of 10,000,000 pesatas. (A pesata is the Spanish unit coin and equal to a franc French or 20 cents American money.) Two architects were chosen, the one to represent the government, the other to represent the contractor, and they were made, jointly, superintendents of the building. Under their joint direction, the contractor performed his work. The sequel proves the wisdom of this arrangement, for the building is erected in a satisfactory manner and apparently without dispute or disagreement. It is the custom among the English and American visitors in Spain to point, with a certain degree of reproach, to the Spanish character as carrying its love of ease and good nature to such an extent as to sap their energy; and to call them in derision, the "Mañana people," because it is said they propose never to do to-day what they can put off till to-morrow. But the erection of this palace, running over a period of time since

1866, costing two million dollars, has been completed so that the contractor was able to deliver it over, a finished building, and move out of it with all his forces within less than two months from the date originally fixed by the contract. The building is in the form of a rectangle. On the longest sides, that is facing east and west (the Paseo de Recoletos and the Calle de Serrano), the building is 446 feet long. On the other sides it is 410 feet long. The principal façade and entrance is on the Paseo de Recoletos, the secondary one on the Calle de Serrano. The building is three stories—a basement and a first and second story. The basement is built of granite, the first and second stories of marble and brick. The projections in the centre and at the corners are made to break the sameness of the long stretch of smooth wall—these projections are of Spanish marble, not clear white, but grey, streaked with yellow, and slightly ornamented with engaged columns or buttresses. The style of the building is of Greek architecture, though of no definite or particular style. The windows are square without caps or other ornamentation and without stile or mullion. They are about 25 feet high and 7 feet wide, and are filled with clear plate glass allowing the utmost amount of light to pass through. The cornice is of the Greek style; the moulding is quite heavy, though in good proportion, and projects above the flat roof which it hides entirely. The building covers a superfice of 16,850 meters. There is slight decoration upon the outside of the building except at the two entrances mentioned. Owing to the lay of the land, the entrance to the principal story is much higher on the Paseo de Recoletos than upon the Calle de Serrano. This fact has been used to advantage in making the former the principal entrance with higher and broader steps, more doors and entrances, greater amount of ornament and decoration, and altogether more imposing in appearance. The approach is by three flights of steps extending the whole width of the façade, with a broad terrace between each one which is utilized by placing pedestals and statuary opposite the pillars or columns between the doors of entrance. Some of these statues are seated and some are standing. Those seated are San Isadore and Alfonso the Wise; those standing are Luis Vives, Lopez de Vega, Nobrija and Cervantes. In various places on the façades and vestibules, are placed medallions representing many of the great men of Spain. On the façade of the Calle de Serrano, the pedestal upon each side of the entering stairway is occupied by immense griffins 20 feet long and 10 feet high, with human heads and breasts, and lion and eagle claws. Outside of these on the pedestals against engaged columns, are respectively the statues of Berreguette and Velasquez. The palace is a magnificent building, plain, simple, in good style and good taste, solid, impressive, not over-decorated, and excellently arranged for its purpose. There are at present, housed and under its roof, three Expositions, one in each story, distinct from each other, and organized by different authorities. That in the basement is entirely Spanish, belongs to the War and Navy Department, and consists of objects furnished by these two departments. On the first or principal story, is the International Exposition Historico-Americano, in which all objects are supposed to have relations to America and belonging to a period prior to 1700. Senor Navarro-Reverter is Delegate-General. The second story contains the Exposition Historico-European. Its objects relate entirely to Europe, but principally to Spain, and have a greater or less antiquity. Padre Fita is Delegate-General. He is a Jesuit Father, a very learned man, an ardent and wise Archeologist, and of unblemished character. His good qualities were such as that when his appeal was made to the church authorities throughout Spain for the loan of their treasures, assuring them of their safety and return, he received such offers of valuable objects as to enable him to fill his entire space with the richest and most interesting.

Let us enter this building. The basement is 20 feet to the ceiling and it has 22 rooms. The first story is 27 feet to the ceiling and has 46 rooms. The second story is 30 feet to the ceiling and has 49 rooms. The principal display rooms or halls form the outside of the rectangle. On the side toward the Calle de Serrano, these halls are 45 feet wide. On the other sides of the rectangle they are but 35 feet wide. The centre of the rectangle is devoted principally to the Library. The Reading Room is in the center, is a most excellent arrangement, and is magnificently decorated. The Standards and Coats of Arms of Spain, of all the Provinces and the principal Cities are here displayed by frescoes upon the walls. Medallions of great scientists, historians, literati, form a part of the decoration. It is 95 feet square, without obstruction to the roof, from which it is lighted by sky-light. The books are to be arranged in stacks running out from this central room like the spokes of a wheel. As we enter the building from the Calle de Serrano, to visit the Exposition Americano in the principal story, a turn to the left takes us into the section occupied by the United States, 6 rooms in all. We can pass from one hall to the other half round the rectangle, and out upon the opposite side, or continue clear around to the place of entrance. The halls containing the displays of the various countries follow in this order:—Nicaragua, Guatemala and Dominican

Republic, Equador, Uruguay, Peru, Argentine Republic, the Museums of Madrid, Costa Rica, Denmark, and the Antilles, which takes us to the opposite entrance, crossing which, we begin again—Portugal, Spain, Germany, Sweden and Norway, U. S. of Colombia, Mexico—the latter occupying the same relative position upon the opposite side of the entrance from Calle de Serrano as does the United States, and occupies about the same space. The Archeological Museum of Madrid occupies interior rooms. The arrangements for light in all these rooms is admirable. There are many windows, they are on both sides of the halls, the inner ones opening upon the interior courts. These courts are without galleries or ceilings, are open to the sky and covered with glass at the same height as the roof, thus affording nearly the same opportunity for light as is given from the outside.

The total number of objects comprising the display of the United States, was as follows:—

Department of Prehistoric Anthropology	5,000
Department of Ethnology	2,200
Philadelphia Exhibit, and Coins, Medals and Money from Bureau of Engraving and Printing, Mint, and U. S. National Museum	4,000
Hemenway Expedition	3,500
Iconographia Columbina	310
	15,310

Not Catalogued—estimated—

Books	1,000	
Photographs	1,500	
Lithographs	500	
Wing Frames	600	
Maps, Pictures	300	
Agricultural Department	100	
Indian Schools	300	
Animals	50	4,350
Total objects,		19,660

Considered as 20,000 objects.

(*To be continued.*)

SCIENTIFIC NEWS.

Contrary to the experience of most summer laboratories this season, the Marine Biological Laboratory at Woods Holl is filled to overflowing. Over 100 students are in attendance, this number being the greatest in the history of the institution. Those in charge report a very gratifying improvement in the ability of those attending.

Dr. H. Kelly Corning, formerly at Prag, is now to be addressed at the Anatomischer Anstalt in Basel.

Friedrich Ziegler, Freiburg i. B., has just published a new catalogue of his wax models illustrating embryological subjects. These models are real works of art, and are most valuable aids in instruction. More or less complete exhibits of them may be seen in Harvard, Johns Hopkins, Bryn Mawr, Michigan University, Chicago University, Clarke University, Cornell, Wisconsin University, Oberlin, Wellesley, Minnesota University, Boston Society of Natural History, Columbia College, Rochester University, University of Illinois, and Northwestern University. The whole collection, as far as ready for the market, includes 279 models, which are furnished for $602.84.

Dr. H. B. Ward, formerly instructor in Zoology in Michigan University, has been appointed Associate Professor of Zoology in the University of Nebraska. After Sept. 15, his address is Lincoln, Nebr. With his appointment Professor E. A. Barbour is relieved of the instruction in Zoology, and will have only that in Geology.

Dr. Zander has been appointed extraordinary professor of Anatomy in the University of Königsberg.

Mr. Edward J. Bles, formerly Fellow at Owens College, Manchester, is now Director of the Biological Station, at Plymouth, England.

Dr. Hermann von Ihering is now the Director of the Zoological Division of the Museum at Sao Paulo, Brazil.

Dr. Adelbert Seitz has been appointed Director of the Zoological Garden at Frankfurt a. M.

Henry Viallanes, Director of the Zoological Station at Arcachon, France, died the last of May, 1893, aged 36 years. He was one of the most promising of the younger French zoologists, and had made the structure of the Arthropod nervous system a subject peculiarly his own.

J. F. M. Bigot, possibly the best known student of the Diptera, died in Paris, April 14, 1893, in his 75th year.

The death of Professor Carl Semper, on May 29, was not unexpected. For some time he had been suffering in health, and lately had done no teaching in the University of Würzburg. He is best known for his prolonged researches in the Philippine Islands, the scientific results of which have formed a splendid monument to his name. He visited the United States in 1876, and gave a course of lectures before the Lowell Institute in Boston, which later were issued in that most suggestive volume, "Animal Life as Effected by External Conditions."

Dr. Eugen Korschelt, formerly of Berlin, has been appointed Professor of Zoology in the University of Marburg.

The attempt to reduce the rate of postage upon natural history specimens sent through the mails of the postal union has failed. Such specimens can only be sent at regular letter rates (5 cents for each half ounce) except to Canada and Mexico, where the rate for such specimens is a cent an ounce. Dried animals, including insects, are excluded entirely from the mails.

Mr. James Wood-Mason died at sea on the voyage from Calcutta to London, May 6, 1893. He was born in Gloucestershire in 1846; was later connected with the Indian Museum, and at the time of his death was Professor of Comparative Anatomy in the Medical College of Bengal. He was best known for his work upon the Morphology of Arthropods, his systematic work on the Crustacea of India and his explorations of the deep waters of the Gulf of Bengal with the dredge.

The Chicago Exposition is furnishing the best opportunity for studying the external characteristics of human races that has ever been presented to Americans. There are colonies of Dahomeyans, Samoans, Egyptians, Javanese, Japanese, Esquimaux, North American Indians, Hindoos, Turks, etc. Every person interested in Ethnology should visit the Exposition.

RECEIVED

NOV 28 1893

THE

AMERICAN NATURALIST

VOL. XXVII. October, 1893. 322

BACTERIOLOGY IN ITS GENERAL RELATIONS.[1]

By H. L. RUSSELL.

Bacteriology, although the youngest member of the biological sisterhood, has developed so rapidly within the past two decades, that to-day it may fairly claim for itself an independent basis. Independent, however, not in sense of isolation from other branches of scientific thought, but as occupying a field that is more or less distinct in itself. The scope of this subject has already widened to such an extent, and the literature grown to be so voluminous, that it is fairly entitled to be ranked as a separate branch of biology. This necessity is also emphasized by the difference in technique, that separates it more or less distinctly from other departments of research.

It was not until the middle of the present century that the affinities of the bacteria were even approximately determined. Zoologists first claimed this class of organisms as belonging to the animal kingdom, but gradually, as bacterial forms became better known, and more fully studied, their plant-like similarities were detemined. Botanists, for many years contributed but little toward a more perfect knowledge of this class, and it is the science of medicine that bacteriology must ever regard as its foster parent. The establishment of the causal relation between these minute forms of organic life and disease, at once invested them with increased importance and made them subjects of paramount interest to the student of medicine. Although the main interest that bacteriology calls forth is still in its relation to medicine, broadly considered, it has proved itself so valuable an adjunct in widely different fields, that as a science, it can no longer be subordinated to any particular subject. To-day, it may fairly be said to exert a powerful influence on a number of widely separated departments of a scientific as well as of applied nature and investigations from a bacteriological standpoint have thrown much light upon many obscure problems in these different branches.

---

[1] Delivered before the Biological Club of the University of Chicago, Feb'y, 1893.

The purpose of this paper is to indicate in a general way the extent of the influence that this science is exerting on other lines of work as measured by some of the results that have been recently obtained. This can be done only in barest outline, if we would compass the entire range of its activities within the limits of a single paper. A rapid review, will however, give us a fuller comprehension of the relation that the subject as a whole bears to other departments of thought. The influence of scientific study is of a reciprocal nature, and the impetus that one branch receives from the discovery of a general principle, manifests itself to a greater or lesser degree in all related lines of study. The relation which exists between this subject in general, and medicine and hygiene must always be most intimate, for it is along these lines that the greatest advance in bacteriology has been made. It is therefore meet that in the consideration of this subject, we should first emphasize the effect that it has produced in the field of medicine, but as this is the phase that is usually presented, allusion to it here will be made only in very general terms.

Perhaps it is not too much to say, that no theory in pathology has been more fruitful of practical results than the germ theory of disease. Not only has it established the etiology of contagious maladies upon a rational and scientific basis, but it has formulated well defined principles of treatment that are now successfully employed, particularly in the departments of surgery and hygiene. What was once blindly accepted as a "visitation of Providence," from which there was no escape, is now known to be due to the action of these minute forms of organic life. To-day we consider them in the light of science rather than the gloom of superstition, and the terror of devastating pestilence is largely diminished when its cause is unmasked.

Perhaps on the whole the greatest benefit that bacteriology has conferred upon the "healing art" lies in the fulfilment of the old adage "that an ounce of prevention is worth a pound of cure." It has shown its value mainly in *preventing* rather than in *curing* disease, so that prophylaxis has gained far more than therapeutics. A more intimate knowledge of the conditions aiding or retarding the development of bacteria has resulted in improved methods of sanitation, by which the physician is able to circumscribe and control an outbreak of contagious disease.

Our knowledge of all the conditions of bacterial development is as yet comparatively limited, but the application of the principles that have already been established, has aided materially in checking the progress of these types of disease. Among these, the cholera epidemic of last year is a notable example. Starting from its native home on the Ganges, where it is endemic, it travelled step by step, following the lines of commerce. Entering Europe by way of Russia, where amid its squalid and famished millions, existed the most favorable conditions for its propagation, it was further spread by exiled Jews, who carried the contagion to many of the commercial marts of western Europe. The history of past epidemics demonstrates that its march westward has been almost always unobstructed, and had we been living in the light of two decades ago, it would probably have ravaged the denser portions of the west, as it has done in the past, and as it does in the east to-day. We may not be able to stamp out the scourge at once, but it cannot be denied that the restrictive methods of the German Government last season, checked the spread of the epidemic in that country, and our efficient quarantine regulations prevented its gaining a foothold in our metropolis. We may not know all there is to be known concerning the character of the contagion, but what we have already learned, points to a more successful method of action in repressing it than any we have heretofore possessed.

Prophylaxis, or preventive treatment, may be carried on in two ways. We may prevent disease, either by destroying the cause of the infection, or by rendering our bodies refractory to the attack of the disease germ. The first is accomplished by disinfection, the latter by preventive inoculation. What Jenner did with small-pox is an entirely empirical manner, modern bacteriology has effected in the light of established principle. The brilliant researches of Pasteur and his pupils along these lines, not only in the case of human infection as in hydrophobia, the mortality of which at the Pasteur Institute at Paris has now fallen to less than one-half of one per cent., but also certain animal diseases like splenic fever in sheep and cattle, erysipelas in swine and cholera in fowls, are practical testimonials of the advance that modern bacteriology has to offer in the direction of prophylactic treatment. The Berlin school, while it has not as yet succeeded in applying its methods in so widespread and practical a way, has placed the question of acquired immunity upon a firmer scientific basis. The discoveries of Fränkel, Brieger, Kitasato, Behring, and Ehrlich are all of supreme importance from an experimental standpoint. These observers have been able to immunize various animals by artificial means against such diseases as tetanus, diphtheria, pneumonia and erysipelas of swine. Not only have they endowed the animal body with such properties that it can successfully antagonize either the germ or its toxic product, but in some cases, have actually restored the animal to its normal healthy condition after the disease had been established.

How far these results can be utilized in combating disease in the human system is not yet definitely known. In the consideration of the probable value of these results to therapeutics, we need to be conservative in our conclusions, for the conditions are widely different between an experimental disease in animals and its natural course in man. From the present outlook, it seems that any permanent advance along this line will be based upon successful efforts in securing artificial immunity. The conditions must first be worked out experimentally upon the lower animals, and it will require patient and extended research before they can be applied to human ills. The most pronounced results so far in this connection, are accomplished by the *blood serum therapeutic methods*, as demonstrated by Behring and Emmerich. This theory rests upon the conception that in an animal artificially immuned, a certain change has taken place in the blood serum by which it has become endowed with antibacterial, as well as with antitoxic properties; also that the serum of an animal thus protected possesses in itself a positive therapeutic value. Kitasato, two years ago, succeeded in rendering mice so refractory toward the poison of the tetanus bacillus, that they were able to withstand an injection of three hundred times the ordinary fatal dose. The serum of these immuned animals when injected into susceptible controls, that had been infected with virulent tetanus cultures was able to arrest the progress of the disease even after the characteristic symptoms of tetanus had been manifested throughout the body. Not only has this course been applied to experimental tetanus in mice, but rabbits, dogs, horses and sheep, all of which are susceptible to the disease, have been rendered refractory by these artifical methods.

This plan of treatment has recently been used in tetanus in man. The curative substance was secured from the serum of artificially immuned rabbits and dogs, and there are already on record over a dozen cases of human tetanus that have been successfully treated by this method of inoculation. Some of the cases were so far advanced that paralysis had already set in, yet the injected material was able to neutralize the toxicity of the poison, and inhibit its further production. The application of this method to other diseases analogous in character promises favorable results, and the problem to-day in this connection, lies not so much in further proof of the theory, as it does in the ability to artificially immunize animals of adequate size to procure the serum in sufficient quantities to be utilized in actual practice. Behring has succeeded with diphtheria in conferring immunity upon rabbits and guinea pigs and has found that their serum is likewise able to check the experimental disease in infected controls. Subsequently he accomplished the same result in animals of the size of sheep, rendering them resistent to the infection, so that the serum in adequate quantities can be secured for use in the treatment of the human disease.

Medical science awaits with intense interest the next step, and it is possible that in the near future "the red demon of the nursery" will be brought under control.

Turning from the beneficent results which have been secured to medicine, to other lines of activity, the results of bacteriological research are equally efficient. Chief among these are some results obtained in reference to agriculture. In its relation to medicine, bacteriology deals mainly with those forms that have adapted themselves to a wholly, or semi-parasitic mode of existence. These however represent but a minor fraction of the whole number of species that have been isolated. In agriculture, saprophytic, as well as parasitic species enter into consideration, and here parasitism is not confined to the animal body as a host, but is to be observed in plant tissue as well. To the agriculturist then, bacteria come in a dual guise. They are both a friend and a foe. Some species are to him a direct benefactor, some render him aid in a more indirect manner, while others are a positive detriment to the success of his calling. How to increase the activity of the friendly forms, and diminish the ravages of the noxious ones, is the constant study of the agricultural bacteriologist.

The field, which for convenience we here classify as agricultural bacteriology, is made up of so many widely separated subjects, that the detailed methods in one class, cannot be successfully utilized in the examination of another. For example, the attempt to isolate the organism of nitrification which baffled investigators for so long a time, was fruitless mainly because they relied almost entirely upon the gelatine method of Koch. Each special subject must be studied by itself and the technique developed for the method of work in establishing the etiology of a bacterial plant, disease differs widely from that which must be used in studying the processes of nitrification or the fixation of the free nitrogen of the atmosphere. In reviewing the progress of agricultural bacteriology, we can only allude to the lines of work which have been opened up in this fertile field of research. It may be confidently asserted that as yet, we stand on the threshold of discovery in this department, and the work can scarcely be said to be more than inaugurated. What the possibilities of the future are, no man can safely predict.

Study in veterinary pathology has gone hand in hand with that of human disease, and the etiology of numerous contagious diseases in domestic animals have been thoroughly investigated. Actinomycosis in cattle, glanders in horses, and splenic fever in sheep besides numerous other septicemic diseases, like hog-cholera, swine plague, chicken cholera, *rouget* or swine erysipelas are classic examples in our textbooks. A fuller knowledge of the history and etiology of this class of diseases, has not only better enabled the farmer to check their spread, both by remedial and prophylactic treatment, but it has awakened an economic interest that is steadily progressing along practical lines.

Besides these parasites, confined to animal organisms, the husbandman has to contend with a series of forms, which only find their normal hosts in vegetable tissue. The farmer and horticulturist need to be always on the alert to protect their harvests from the ravages of these enemies. Insects and fungi are an ever present menace to success, but not a small number of plant maladies are to be traced directly to a bacterial source. Such destructive diseases as the apple and pear blight, the tuberculosis of the olive, the "yellows" of the hyacinth, as well the blight of oats, sorghum, Indian corn, and other cereals are often due to an invasion of germs of a bacterial nature. The conditions by which these diseases are propagated and spread are such, that some of them can be eradicated, now that we know how the infection is transmitted. To illustrate, the pear or fire blight, which has been observed in this country for a hundred years, and which in some sections has become so destructive as to practically ruin the industry, can now be managed with comparative ease. Through the researches of Waite, it has been ascertained that the infection is transmitted by insects in their visits to the flower for nectar. The germs thus carried from an infected to a healthy tree are deposited on the nectary as the insect garners the honeyed store. A lodgment effected, the germ finds a rich nutrient medium and it multiplies profusely, penetrating finally the exposed cells of the nectary, which are destitute of a cuticle. With an entrance once established, the contagion spreads from blossom to twig, from twig to branch, until at last the whole tree structure becomes involved, and falls a prey to the disease. Since we have learned that the blackened leaves and branches contain the virus, it becomes only a matter of watchfulness and care on the part of the husbandman to check and ultimately stamp out the malady by the excision and burning of the diseased tissue.

Another problem of vast importance not only to agriculturists, but to sanitarians, is the subject of nitrification, or the conversion of nitrogen bearing substances into nitrates and nitrites. It has been an established fact, known for years, that under certain conditions, there was an increase in the nitrous and nitric salts in the soil, but just how this was brought about, was for a long time an unsolved problem. Chemists had explained the phenomenon on a purely chemical basis, and it was believed that the nitrogen of the air was oxidized, either by the action of ozone or oxygen. Pasteur as a result of his studies on fermentation was the first to suggest that the production of nitric acid in the soil might be due to organized ferments. This idea was taken up by Schloesing and Müntz fifteen years ago, and the working out of the present accepted biological theory of nitrification is largely due to the untiring labors of these eminent French investigators, as they laid the basis for the more brilliant and successful results of Winogradsky and Warington.

Interesting as is the story, time will not permit entering upon the detailed steps by which the germ theory was finally proven. For a number of years after it had been shown that organized ferments played the chief rôle, no advance was made in the isolation of the organism as the different investigators failed to produce any nitrification with the germs they had separated from the soil. Warington states, that over a hundred different species of bacteria had each been carefully tested as to their ability to nitrify ammoniacal solutions and that with every one a negative result was reached. It is less than three years ago that the efforts of bacteriologists to obtain the specific cause of the process were crowned with success. Frankland isolated the germ by dilution, and at the same time Winogradsky succeeded in separating it by another process. The unique feature of this germ was that they could not make it grow upon gelatine. This peculiar individuality explained the failure of previous investigators who had confined their methods to gelatine media. Experiments demonstrated that this germ was only able to oxidize ammonia into *nitrous* acid. Important as was this discovery, it was only one step in the process. The conversion of nitrous acid and its salts into the more stable nitrates, eluded their best efforts.

Winogradsky at last succeeded in isolating the organism from mixed cultures by the use of gelatinous silica mixed with inorganic salts.

In this way the various steps of the process were clearly demonstrated and the biological theory of nitrification was established upon a firm and scientific basis. This theory claims that the nitrification of ammonia in the soil takes place in two successive stages, the change in each case being produced by distinct and separate organisms. In the first stage ammonia is oxidized into nitrous acid and then this is acted upon by another (a second) organism and is converted into a nitrate. Ordinarily, as observed in nature, the two processes occur simultaneously so that the ammonia passes in continuous combination from its simpler form into its ultimate stage as nitric acid, or some of its salts. The economic value of this discovery cannot be estimated. It is not only a complete and satisfactory scientific solution of a complex process, but is of invaluable aid to the agriculturist in demonstrating to him the source of the most essential element in soil restoration and in teaching him how he can best conserve and utilize this expensive product.

It has also an important bearing upon certain phases of hygiene for the success of the intermittent filtration of water through the soil seems to be based upon the nitrifying action which takes place within the filter. Filtration has been in use a long time as a means of water purification and the theory that bases its efficiency in the mechanical or chemical separation from its impurities has long been the accepted one.

Many of the observed facts did not seem however to accord with this explanation, and when it was found that certain protoplasmic poisons like chloroform injuriously affected the efficiency of filters, the relation between it and living organisms was suspected. This led to a careful study of the question from a bacteriological standpoint, and the discovery was soon made that there was a direct relation between the process of nitrification as it went on in the filter and its effectual operation.

The solution of another interesting subject, that of the fixation of the free nitrogen of the air by certain plants, also bids fair to be solved by bacteriological methods. Agriculturists long ago recognized the fact that certain species of plants belonging to Leguminosæ, such as clover, alfalfa, etc., possessed special properties in enriching the soil; that not only could these crops dispense with the application of fertilizers, but that they possessed the elements by which impoverished soils might be restored to their original fertility quicker and cheaper than by any other method. This knowledge, the fruitage of observation and experience awakened an interest in the causal relations between the one and the other, productive of many interesting and ingenious hypotheses. Liebig concluded that as clover could be grown upon the same ground for years without the addition of fertilizers, that it must absorb nitrogen direct from the air through its aerial organs, and then transfer this store to the roots, and so enrich the soil. Carefully conducted experiments have failed however to reveal any direct absorption by the leaves and stems of plants. This peculiar property, limited so far as we at present know, to the Leguminosæ was finally correlated with the presence of small excrescences or tuberculous swellings on the roots of these plants. These are found in great profusion on the young rootlets of this class of plants, and seem to be universally absent in all other genera.[2]

For a long time they were regarded as pathological structures, and it was only when it was found that legumes grown in *sterilized soil* were poorly nourished and entirely devoid of tubercles, that the causal relation of these structures with the peculiar property of the plant was recognized. These observations were followed by more systematic experiments by Hellriegel and Wilfarth, who discovered that the production of the tubercle depended upon the germ contents of the soil. Beyerinck, Prasmowski and others succeeded in isolating the germ which possessed the ability to penetrate the young root hairs and the cortical parenchyma of succulent roots. These bacteria set up an irritation in the plant tissue that causes the formation of a meristem, and thus the tubercles are produced as lateral outgrowths from the root.

The tubercle is filled with. peculiar shaped bacteria, which possess the ability in some way not yet perfectly understood, of fixing the nitrogen of the air in such a condition that it can be utilized by the plant. Our knowledge concerning the details of the process is far from complete, but this rational explanation of the phenomena has opened the way for further research. The problem that at present awaits solution is to find whether there is any difference between the organisms infecting one variety and those that are symbiotic in another.

The artificial selection and cultivation of these forms that have the greatest ability as " nitrogen collectors " is a question of prime importance. Like that of nitrification it involves great economic interests, inasmuch as it is the key to the solution of the important question of the restoration of impoverished soils.

It would be treating our subject in a very imperfect manner were we to close our résumé of the influence that bacteriology has exerted upon argricultural pursuits without stating the position of it with reference to dairying.

---

[2] Recent experiments (Landw. Vers. Stat. XLI, 138) seem to indicate that the tubercles on the roots of *Elæagnus angustifolia*, a member of the Elæagnaceæ, a close relative to the Leguminosæ are developed by bacteria. Infection by means of soil washings of sterilized soil planted with these seedlings gave more luxuriant growth than controls in sterilized soil. The organism has been isolated in pure culture and is found to differ from *Bacillus radicicola*, the form so common in the legumes.

Milk, like every other organic substance, is subject to certain changes, and these conditions are now known to be directly traceable to the influence of micro-organisms. These so-called "diseases" of milk are mainly fermentative in their character and modern bacteriology has shown the dairyman that they can be entirely prevented if he handles his product in a rational way. Milk, as it comes from the cow, is entirely devoid of germ life, but its high degree of temperature when freshly drawn and the exceedingly nutritious food medium that is offered, afford the optimum of conditions for the development of any bacteria that find their way into the fluid. The ubiquity of distribution of fermentative organisms render it impossible to entirely avoid their action, but the losses of the milk-dealer can be greatly diminished if cleanliness is scrupulously observed.

While the milkman wishes to avoid bacteria as far as possible, the buttermaker should welcome them as his friend. Many forms are, of course, undesirable, but from the recent investigations in this field there is no question but that the bacterial content of butter largely influences its keeping qualities as well as the peculiar flavor for which such fancy prices are paid. The process of "ripening" or "souring" cream that is practiced by every butter maker is a natural bacterial fermentation. Better and more butter is obtained from ripened than from "sweet" cream. If this is so, the question naturally arises, Why can we not isolate the forms that are capable of prorucing these changes and add them directly to the cream rather than to trust to their spontaneous development? The researches of Hansen in the realm of pure yeast ferments have revolutionized the brewing industry within the last five years, and the introduction of pure cultures of yeast for fermentative purposes has made a better, and what is still more important, a more uniform product. Now the same field seems to be opening in the process of butter-making. Danish and German creameries are now being supplied with pure bacterial cultures that are early added to the cream in order to produce as a result of the fermentative changes the desired flavor.

In this way uniformity of product is assured, and as many undesirable forms are choked out by the introduction and control of pure cultures, the keeping qualities of the butter are much improved.

The utility of bacteria in connection with milk and its products may still be further extended, for the necessity of their presence in cheese making is even more imperative than in butter making. Here they are an indispensable requisite to the production of a palatable product. New cheese is flat and insipid, and it requires a certain period of time in which it undergoes a change that is called the ripening or maturing stage before it is fit for use. Duclaux and others have shown that the production of the delicate flavors are due to the transformation of the casein into soluble albuminoids by means of the ferments that are produced as a result of bacterial growth. This ripening process is then due to the action of specific germs. The various kinds of cheeses that possess such a variety of flavors are, no doubt, due to the action of different forms of bacteria, but the threshold of this work is scarcely more than crossed, and, as one of the leading experts in this country has said, further advance in perfecting the processes of cheese manufacture is impossible, unless they include the aid of bacteriology.

(To be continued.)

A CASE OF LATEROVERSION OF THE OPHIDIAN HEART.

By Pierre A. Fish.

The specimen had already been partially dissected by one of the laboratory students in the Anatomical Department (Cornell) before attention was called to the peculiar cardiac arrangement.

The body had been divested of its skin until within six centimeters of the vent and seven centimeters of the tip of the mandible; the cranium had been removed, leaving the mandible still attached to the body; the heart had been exposed and the ventral portion of the pericardial sac, if any had existed, was gone. A normal specimen was put into the hands of the student for further dissection and the anomalous one has awaited careful examination since 1891.

Enough characters remained to enable one to identify it with a reasonable amount of certainty as *Ophibolus doliatus* var. *triangulus* or as commonly known, the spotted adder or milk snake.

Its total length was 85 centimeters (2 feet 10 inches); from the tip of the mandible to the apex of the heart the distance was 11 centimeters, the heart itself from the apex of the ventricle to the base of the right auricle being 1·8 centimeters.

The interior of the pericardium (already exposed) presented a somewhat cone-shaped cavity through the length of which, and a little to the right of the mid-line, the pulmonary and post caval veins passed. These did not lie freely in the sac but were held in place by a narrow, but distinct fold projecting from the dorsal wall of the pericardium.

A considerable depression for the reception of the ventricle was formed just cephalad of the auricles by a sinistral deflection of the trachea and œsophagus; the trachea also showed signs of compression on the side adjacent to the heart. No trace of a true pericardium was apparent here, but there seemed to be a somewhat excessive development of connective tissue.

Aside from the very peculiar position of the ventricle, one of the most striking features was the unusual engorgement of the vessels of the left side with blood, in the immediate proximity of the heart. The left auricle also presented this feature while the right was comparatively empty.

A superficial examination of the conditions seemed to show that there had been a complete ante-version of the whole heart, the ventral surface becoming dorsal and the dorsal ventral. On carefully removing the dense connective tissue covering the surface of the ventricle, this conclusion was shown to be erroneous from the fact that the aortic arches were found to arise from this apparent, and at the same time real ventral aspect. This as well as some theoretical reasons would demonstrate quite effectively that true ante-version could not have occurred.

What appears to be the most logical inference, and dissection seems to confirm it, is that rotation must have taken place, the fixed point being at about the place of divergence of the two aortic arches; and since the apex of the ventricle points in a diametrically opposite direction to that found in the normal condition, it must therefore have passed from right to left and through an arc of 180°—provided the heart was ever normal. The apparent left side of the ventricle would then be the true morphological right side and *vice versa.*

The auricles would naturally tend to follow the ventricle in this rotation, but there is no very marked displacement of their relations to each other. This does not hold true with regard to the ventricle in its new location, for the apparent right, but really the morphologically left side is in a line with the right auricle and the morphological right side is in a line with the left auricle.

An effectual restraint would be offered against this migratory tendency of the auricles, in the case of the right auricle by the pulmonary vein which would prevent its passing the mid-line. And similarly for the left auricle by the left aortic arch, which would prevent any movement of the auricle in a cephalic direction. The usual disproportion of size between the two auricles is not evident, though this may be accounted for by the collapsed condition of the right as compared with the left side. The ventricle if it has rotated must have passed along the ventral aspect of the left auricle.

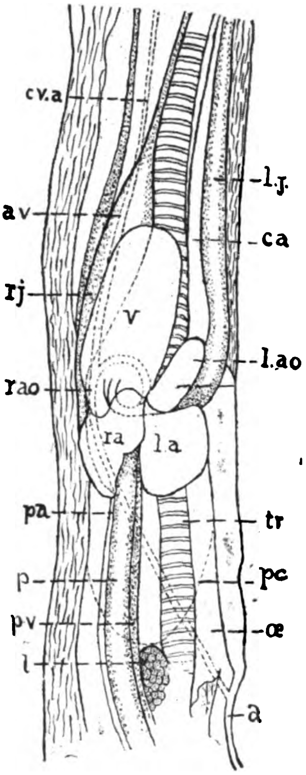
After a careful and completer dissection of the heart and the vessels adjacent to it so that the parts could be more easily manipulated, it was found that the ventricle could be returned to an approximately normal position which assisted quite materially in elucidating the relationship of the vessels to the heart and to each other.

The two aortas at their diverging point are twisted half around each other, the right in this case being smaller than the left and sending off only one branch—the cervical artery; the right aorta then passes dorsad of the trachea and œsophagus in an oblique caudal direction until it meets the left to form the common aorta.

The left aorta presents a peculiar enlargement shortly after emerging from its "twist," due perhaps to over-distention with coagulated blood, and at the point of the greatest convexity of its curve it sends off the carotid artery and gradually diminishes in calibre until it meets its fellow. It would appear from this that the left aorta, instead of being a mere connecting branch as is usually the case, has assumed the chief function of the right, supplying the head with blood through the carotid. The two aortas retain their crossed origins at the ventricle as in normal specimens. It is not improbable that the right aorta suffers more by the twisting than does the left, causing a greater retardation of the flow of blood and thus offering a possible explanation for its diminished size and partial loss of function.

The right jugular vein was somewhat enlarged near the heart but empty and was partially compressed by the ventricle. At about the level of the auriculo-ventricular furrow it receives the (pre?) azygous vein and the common venous trunk, which is of smaller calibre than the jugular, then follows the dorsal contour of the right auricle, arching over to enter the sinus venosus at about the point of entrance of the postcava.

The position of the sinus which normally is perhaps more dorsal than lateral has, on account of the rotation, assumed a more nearly mesial and ventral location, thus bringing the postcava in line with the pulmonary vein to which it seemed to be quite closely adherent. The left jugular vein likewise presents a central enlargement and forms a sling-like support for the arch of the left aorta.



In the intricate and unusual arrangement of the parts here, the vein was inadvertently cut so that its course to the right auricle could not be satisfactorily determined.

The pulmonary vein passes from the lung through the pericardial cavity accompanied by the post-cava and passes between the two auricles more ventral than dorsal and enters the left auricle.

The significance of the central enlargements of the left aorta and the carotid artery and of the left and right jugular veins is not apparent, unless they may in some way be correlated with the anomalous position of the cardiac parts. These vessels nearer the heart are of smaller calibre, and on account of their twisted condition must retard the flow of blood considerably, the enlargements, then, may function as reservoirs for a reserve blood supply.

Such factors as gravity, pressure, mode and direction of progression would militate against the view of a post-natal development of this anomaly and would render more plausible the idea that it was due to some congenital or fortuitous embryonic condition.

The accompanying figure was traced from a photograph enlarged three diameters, the veins are shaded; the dotted lines indicate vessels that were too deep or insufficiently dissected to show at the time of photographing, and have been filled in freehand.

Specimens of *Eutænia sirtalis*, *Tropidonotus sipedon*, *Crotalus horridus*, and *Python molurus* were used for controls. Among them some interesting facts were observed which may serve as a basis for a future paper.

Reference letters. *a*, common aorta; *av*, azygus vein; *ca*, carotid artery; *cva*, cervical artery; *l*, lung; *la*, left auricle; *lao*, left aorta; *lj*, left jugular; *œ*, œsophagus; *p*, postcava; *pa*, pulmonary artery; *pc*, pericardium; *ra*, right auricle; *rao*, right aorta; *tr*, trachea; *v*, ventricle. Magnified 2 diameters.

PHYLOGENY OF AN ACQUIRED CHARACTERISTIC.

By Alpheus Hyatt.

An acquired character is a modification which makes its appearance in the adult or later stages of development and is obviously dependent for its origin upon other than hereditary causes. I have elsewhere defined that branch of science which deals with such problems as Ctetology and such characters as ctetic or acquired. The characteristic dealt with in the paper of which this is an abstract, is of essential importance among Nautiloids and Ammonoids or all of the Cephalopoda having chambered shells and living within their shells. It consists mainly of an impression made on the inner side or dorsum of each outer whorl during the coiling up, as the whorl grows and is moulded over the venter or outer side of the next inner whorl.

This matter will be better understood, if a short description is given of the following figures. Figs. 1–2 show an almost

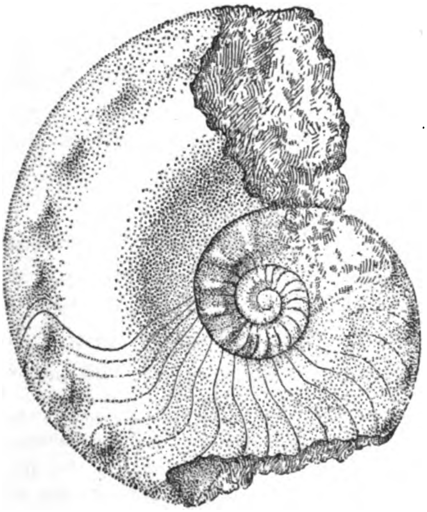


Fig. 1.

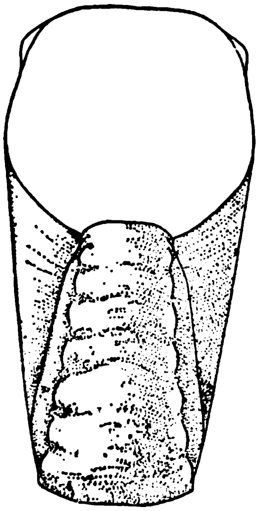


Fig. 2.

complete fossil cast of a full grown *Metatoceras cavatiformis* Hyatt, and some of the lines or sutures made in the external surface of the cast by the intersections of the partitions or septa that cut up the coiled tube of the living shell into air chambers. Figs. 3–4 show a broken specimen of the same species, but with the outer and older whorls in large part removed. The innermost septum near the center of the coil was built across the interior after the animal had constructed the hollow apex or point. It then moved along adding to the external wall of the tube, which has been destroyed and removed from this cast, and built the second septum, and so on until it reached the tenth septum. By some freak of fossilization a number of the septa beyond this have been destroyed, so that if we were to remove the fragment of the external whorl and take out the center which has just been described, this would have the exact aspect of a cast of a young shell with ten air chambers.[1] The eleventh air space or chamber being open and without divisions would then appear to be the living chamber which the animal occupied when it built the tenth septum. Normally the shell really continued to progress from the tenth septum by additions to the outer

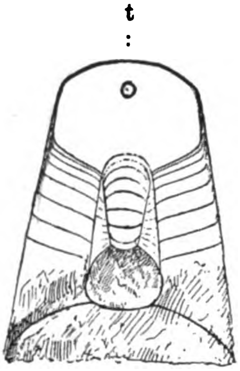


FIG. 3.

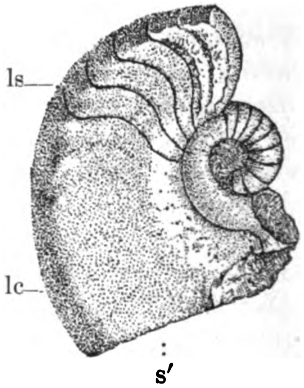


FIG. 4.

---

[1] The shaded area in the center, shaped like a large inverted comma, was an open space in the living shell. This is almost invariably filled by the rocky matrix in which the shells occur and is often, as in this specimen, allowed to remain. See also figs. 4, 5, 6, on Pl. XVIII, which show the comma shaped umbilical perforations or openings left at the center through the crytoceran form of the young.

wall and put in new septa behind it, together with the connecting tube until it reached s′, and finally the last septum, l. s. This one, l. s., was really the last one built and it formed the floor of a true living chamber, l. c., formerly occupied by the animal at the time of its death and burial in the sediment of the Carboniferous period. Figs 1–2 show a similar fossil but with a longer, although still incomplete living chamber. If the external wall of shell had been preserved none of these structures could be seen. Figs. 5–7 show a fossil *Temnochilus crassus*, a shell of the same family with this external wall preserved and all these internal structures covered up. The impressed zone is the re-entrant curve shown in all these figures and especially marked in the lower outline of an outer whorl of another Carboniferous species, *Metacoceras dubium* Hyatt, fig. 8, im. z.

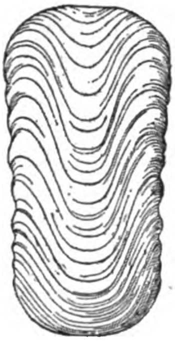


FIG. 5.

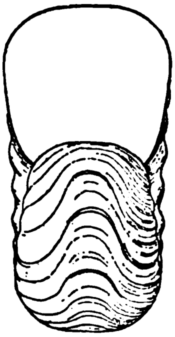


FIG. 6.

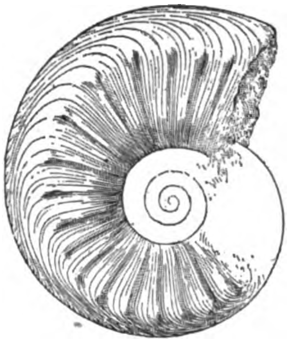


FIG. 7.

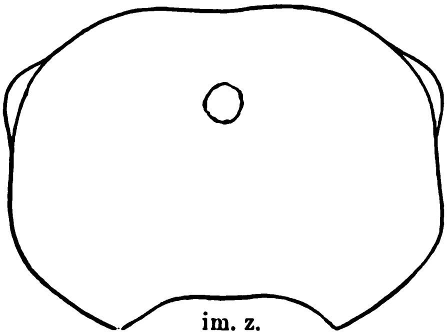


FIG. 8.

It is not necessary to go into a discussion of the details of internal structures and their relations to the impressed zone in this abstract, but it is essential to give a general description of the morphogeny of the order of Nautiloids.

This group of chambered cephalopods contains the following classes of forms: first, straight, conical shells, type Orthoceras, pl. XVIII, fig. 1; second, curved cones, Cyrtoceras, pl. XVIII, fig. 2; third, loosely coiled, open whorled cones, Do., fig. 3; fourth, coiled cones with the whorls more or less enveloping, Do., fig. 5. The fourth and fifth forms are usually included in the old genus, Nautilus. Practically, it is better to designate the first class as orthoceran, the second as cyrtoceran, the third as gyroceran, and the fourth and fifth as nautilian. In tracing genetic series through time they are found to diverge in their evolution, starting with the orthoceran and passing through parallel lines of forms, many of the genetic series having in succession cyrtoceran, gyroceran and even nautilian forms of the fourth and fifth classes. Others are not so perfectly parallel, stopping short with the cyrtoceran class of forms or the gyroceran. Many also begin with cyrtoceran shells, while others diverge from the gyroceran, and still other series have only nautilian shells of different grades of close coiling and involution.

The application of the law of repetition in heredity to the chambered shell-covered Cephalopods, shows that the straight orthoceran shells, pl. XVIII, fig. 1, were repeated in the young of the curved cyrtoceran forms, pl. XVIII, fig. 2, and these forms in their turn in the young of the gyroceran forms, pl. Do., fig. 3; and this may be seen by comparing the young or apical part of each shell represented in outline with the full grown shells of the preceding figures. The apex of fig. 2, with the whole of fig. 1; the apex of fig. 3, with the whole of fig. 2. It will be understood, of course, that the figures in outline represent full grown shells, except when otherwise explained and that they were built like the shells of figs. 1–2, by an animal living in their interiors and adding band after band of shelly matter to the exterior, but in these outlines the shell is supposed to be perfect and the internal structures concealed.[2] The young of pl. XVIII, fig. 4, which represents the fourth class of forms repeats the cyrtoceran form, then curves more closely and just before it comes in contact there is a short time when it overlaps the apex without touching it. At this time it is plainly gyroceran like the whole of fig. 3. After it touches the first whorl just beyond the apex it remains in contact and the inner side or dorsum of the second or overlapping whorl begins to show a flattening as a result of this collision of the whorls. The sections of the orthoceran, cyrtoceran and gyroceran whorls show no such flattening in any of the specimens examined, although hundreds of different kinds have been studied. The sections are designated on the plate by the same letters as the supposed lines of the sections made through the tube, and although diagrammatic figures, they give a sufficiently clear general explanation of the facts observed. More specific figures could have been given in abundance and will be given in the paper now in course of preparation.

Pl. XVIII, fig. 5, shows the same phenomena as figure 4. The young is at first cyrtoceran like the adult whorl of figure 2, and open, then becomes gyroceran in curvature and finally overlaps the apex when it has arrived at the end of the first volution, but does not at first touch it. Then coming into contact it acquires a flattened area or faint impressed zone on the dorsum or inner side of the second volution as is shown in the section fig. 5c. This is similar to the section of figure 4 shown in fig. 4c′, which represents a cut through an adult whorl of the fourth class of forms. It differs only in being smaller on account of the younger stage of growth at which it occurs.

The entire series of forms from orthoceran to nautilian is more or less represented, even in the earliest period at which the Nautiloids appear, namely, in the rocks of the Quebec Group. There is, however, this qualification: the fifth class of forms, or the involute nautilian, are comparatively rare and become more abundant in successive periods. The young of Nautilian shells of the earlier periods are also not so closely coiled, or, in other words, remain open and similar to cyrtoceras for a longer time during their growth. This is shown by the large size of the central hole, or umbilical perforation, left in the center of full grown shells. This perforation is much larger, as a rule, in Paleozoic than in the Mesozoic forms.

---

[2] Except in fig. 9 in which a portion of the shell is broken away showing the cast of the interior and the sutures.

In each period the genetic series or groups of nautilian forms have peculiarities of structure in the sutures, ornaments apertures, etc., by which they can be separated from each other and these peculiarities are the same as those possessed by gyroceran, cyrtoceran and often orthoceran shells which occurred often earlier in time so that one can trace each group of nautilian shells back to its ancestors through the parallel stages of evolution above described. The groups, in other words, are parallel in their morphogenesis, like two individuals of the same parents in their development from youth to old age.

In all of these cases the impressed zone originates as described above after the whorls come in contact, never before this time in the growth of any individuals. Barrandioceras is one of the most involute shells known in the Silurian, and pl. XVIII, fig. 6, gives a true sketch of this species; fig. 7, shows a section of a full grown shell with a decided impressed zone; and fig. 8, is the young. This last is a purely cyrtoceran form with a compressed elliptical section like that of fig. 7, but no impressed zone, the inner side being rounded like the diagram of Cyrtoceras, fig. 2. The impressed zone is not present in the young of Ophidioceras, the closest coiled of all these forms, nor in the young of any species of the Silurian before the whorls touch, so far as known, and all of the species likely to present this peculiarity have been investigated.

The impressed zone is also invariably lost in the oldest stage of the whorl of every individual when the whorls cease to continue to grow in contact. This condition is represented in the last part of the outermost whorl of figs. 4 and 5 in sections, figs. 4e, 5e, and in the outlines of their apertures which are elliptical. The sections represent cuts through the whorls when, as is the case in extreme age, these cease to increase in size. As soon as this senile contraction begins to occur the sides shrink, becoming narrower, the amount of involution becomes less, and the impressed zone, shrinks in breadth as shown in the sections. When the whorl finally parts company in consequence of continued contraction the already shrunken impressed zone, figs. 4d, 5d, rapidly disappears and the apertures of such shells are frequently as round and free from indentations on the inner as on the outer side, as is shown at the free end of the figures 4 and 5.

In normally uncoiled forms, usually named Lituites, when the adult or young is coiled, and the succeeding stages, whether representing adults or old shells, are uncoiled, the phenomena are similar. The impressed zone is lost after the growth ceases to bring the whorls of the shell into contact.

The young and the adults of many of these forms have now been observed in the earliest periods and it is, therefore, obvious that during these early times the impressed zone must have been a modification of the whorl which took place in consequence of the mechanical effects produced by close coiling. This characteristic is slight when the coiling is slight and is developed in precise proportion to the increase of coiling or involution of the whorls and, on the other hand, when through degeneration due to age, or to other causes, the whorls cease growing in contact, the impressed zone gradually disappears.

Thus it always appears preceded and accompanied by an observable tendency in the mode of growth toward closer coiling and that this tendency is quite capable of producing the impressed zone can hardly be denied with any show of reason, since the charateristic disappears in proportion as the pressure is relieved through the degeneration of the powers of growth force to continue the normal rate of progressive increase of bulk in old or young or prematurely degenerate shells and in uncoiled whorls of all kinds and all ages.

The shells of Devonian series of Nautiloids have also been extensively examined, especially in the more involute nautilian forms of the genus Nephriticeras, and so far not one has been found with the slightest indication of the presence of an impressed zone in the cyrtoceran or gyroceran stages of development. In several examples also, the disappearance of this characteristic has been observed in the last stages of old whorls. There is, therefore, every reason for regarding the impressed zone as a ctetic characteristic acquired in the later stages of growth and not hereditary so far as is known in any shells of the earlier paleozoic periods.

The same statement may also be made with regard to the majority of Carboniferous shells. There is, however, a notable exception in *Coloceras globatum* (sp. De Kon.) Hyatt, and very likely some other species of closely coiled nautilian shells. In *C. globatum* of Visé, Belgium, I found in seven specimens that the impressed zone appeared while the whorl was still in the cyrtoceran stage. Pl. XVIII, figs. 9–10, give outlines of the adult of this species, and figs. 11–12, of the young and the zone, showing that the impression appeared long before the whorls touched each other and began to assume nautilian characters. Section, fig. 13b, shows the impressed zone occurring in the cyrtoceran stage while the venter or outer side of the whorl was rounded. Such facts admit of but one explanation, namely, that in this species the impressed zone had become hereditary and was in consequence repeated at an early age, previous to the occurrence of close coiling which produced it in the ancestral forms of the same group.

There are certain correlative characters which lead me to think that this is only a partial statement and perhaps a more complete and better one would be as follows: that the impressed zone, together with a peculiar broadening out of the dorsum and helmet-shaped section of the whorl, and perhaps also certain forms of sutures occurred in the early stages of some Carboniferous species before the nautilian stage, and consequently they must have been introduced by heredity into the development of this species before the tendency to close coiling had completed the first whorl. Thus these characters, although purely ctetic in origin, were repeated before the usual conditions recurred in the ontogeny of this species which had obviously and repeatedly produced them in the nautilian forms of the earlier paleozoic and the more generalized genetic series of the Carboniferous. That this species, *Col. globatum*, is a highly specialized species is shown by other characteristics, especially the early inheritance of a furrowed abdomen, shown at v in Pl. XVIII, fig. 11, and a peculiar aperture.

The Triassic period is unimportant in this connection since it has but few nautilian species that are deeply involute and also sufficiently well known to throw any light upon this problem. All of the true orthoceran, cyrtoceran and gyroceran forms diminish in the Carboniferous and disappear with the Trias.

The Jura contains a considerable number of nautilian shells of different genera of which the cyrtoceran stages are sufficiently well known. *Cenoceros aratum*, of which several specimens have been studied, shows the impressed zone and correlative characters in this stage; *C. lineatum* is the same; *C. clausum*, same; *C. intermedium*, same. Pl. XVIII, fig. 14, shows the cyrtoceran stage in a shell of *C.* , with a well developed impressed zone, i. z. Endolobus is a characteristic paleozoic type and there is a single survivor of this series in the Jura, *End.* (*Naut.*) *excavatum* sp. D'Orb. It is, therefore, very interesting and instructive to note that this species has the impressed zone, according to D'Orbigny's figure, during the cyrtoceran stage. This species has a large umbilical perforation and is slower in coiling up than other Jurassic species. The evidence that the impressed zone and its correlative characteristics are inherited in most species of the Jura before the habit of close coiling could have acted upon the whorls so as to produce this modification is, therefore very general and convincing.

The leading characteristic of parallelism in all genetic series of Nautiloids is, as may be inferred from the facts cited. a tendency toward closer coiling and greater involution in the more specialized forms of each separate series and a correlative increase in the profundity of the impressed zone. When the impressed zone becomes inheritable in some closely coiled and involute specialized shells of the Carboniferous and in similar shells in about all of the genetic series of the Jura this result is also directly connected with the observed fact of the quicker development of the coiling up tendency in the young of these Jurassic shells. This is shown by the small diameter of the umbilical perforation in the centers of the shells of the Carboniferous. It is also connected with the fact that the primitive uncoiled forms, orthoceran, cyrtoceran and gyroceran shells begin to die out in the Carboniferous and cease with the Trias as mentioned above.

This demonstration of the characters that accompany progress in close coiling, enables me to fill a gap which occurs in the evidence during the Cretaceous. In this period the existence of the impressed zone during the cyrtoceran stage of individuals has not been clearly established by observation except in two species, a form allied to *Cymatoceras pseudoelegans* D'Orbigny, from Faxoe, and *Cymatoceras elegans* from Rouen. In other shells, although a considerable number have been broken down, the state of preservation has been invariably imperfect. The coiling, however, in the young of all the shells examined is notably more accelerated than in the similar shells of the Jura, and the whorls broader and having more specialized characteristics correlative with closer coiling and the early existence of an impressed zone. It is, therefore, fair to infer that the evidence when accessible will confirm the facts observed in previous periods.

The same arguments apply also to the Cenozoics, except that in this period there is as yet no evidence of the early inheritance of the impressed zone. I have not yet succeeded with the Aturia, which is the only genus represented by favorably preserved specimens within my reach, in exposing the apex of the whorl. The shells of this period, so far as I know them, are, however, excessively involute and have exceedingly small umbilical perforations with very deep impressed zones after the whorls touch. The umbilical perforation in Aturia is in fact smaller than in any nautiloid known to me.

The imperfect evidence so far gathered in the Cretaceous, and the absence of positive evidence in the Cenozoics, does not, therefore, seriously affect conclusions reached. in this paper, since these are merely gaps in the history of the evolution or phylogeny of the impressed zone; and all the correlative characteristics which accompany the inheritance of the impressed zone in the cyrtoceran stages of species which have this peculiarity have been observed to be present.

The terminal members of the Nautiloids are, of course, the existing species. *Nautilus pompilius* has been examined in a considerable number of specimens and in all of these the impressed zone and correlative helmet-shaped whorl and broad flattened dorsal side appears during the cyrtoceran stage. Pl. XVIII, figs. 15–16 are outlines of the shell of this species during the cyrtoceran stage exhibiting the helmet shaped whorl, broad dorsum, or inner side, and its impressed zone, iz. Thus, when the whorls touch, as in all the nautilian shells of the Carboniferous, Jura and Cretaceous in which the same acceleration of development also occurs, the whorl is already prepared to become involute and to mould itself more readily and rapidly over the surfaces of the apex and the side of the succeeding whorls. In other words, heredity has begun the work before the whorls touch, and before the deepening and enlargment of the impressed zone through the pressure of close coiling is begun. There are quite a number of characteristics in the species of existing Nautili which lead to the inference that they are survivors of Jurassic and generalized Cretaceous and Cenozoic forms; the size of the umbilical perforations, the smoothness of the shells, the simplicity of the sutures, and so on. These facts are of importance only in so far as they show that the existing Nautilus does not represent the acme of progress of its order but is a descendant of shells with less complicated structures than many of the genera of the Carboniferous, Jura, and Cretaceous.

EXPLANATION OF PLATE XVIII.

LETTERING.

a. Apex of shell. This usually bears a scar on the point, as shown in figs. 14 and 15, but this has no bearing on the question discussed, and has not been described. This also represents the youngest or cyrtoceran stage in the growth of the shell, fig. 8 being a young shell with complete living chamber. This letter also indicates the location of the sections correspondingly lettered in the figures.

b is used to indicate the section of the cyrtoceran stage in figs. 11–13.

b′ is used to indicate the place of the sections, figs. 4–5b′, upon the whorls of figs. 4–5. They were taken through the whorl in the gyroceran stage.

c is used for the adolescent stage of growth in the whorl and the corresponding sections.

c′ is used for the full grown stage in the growth of the whorl and the corresponding sections:

d for the first part of the senile stage:

e for the final and most degenerative part of the senile stage:

i. z. for the impressed zone.

v venter or outer side of the shell, the dorsum being the inner side of the whorl.

w for the whorls, thus 1 w in figs. 3 and 4 means the end of the first whorl, 2 w the beginning of the second whorl, 3 w that of the third whorl. These letters serve to show the progressive increase in numbers of the whorls in the different classes of forms.

FIGURES.

Fig. 1. Outline of an orthoceran shell.

Fig. 2. Outline of cyrtoceran shell.

Fig. 3. Outline of gyroceran shell.

Fig. 3. Outline of nautilian shell, having a larger umbilical perforation at (a) and fewer whorls at the same age, than in fig. 5, in other words it is less tightly and completely coiled up than the class of shells represented by that figure.

Fig. 5. A nautilian shell with tighter coils than in fig. 4 and the whorls coming in contact and the impressed zone beginning at an earlier stage.

Fig. 6. Barrandioceras——(sp. Barrande) Hyatt, showing the most involute of the Silurian shells so far as known; fig. 6 is reduced in size but the section fig. 7 is natural size.

Fig. 8. A young shell of the same, natural size, with complete living chamber.

Fig. 9–10. Coloceras globatum (sp. De Koninck) Hyatt, adult. Fig. 9 has a part of the outer shell broken off showing the edges of the septal partitions (sutures) as lines on the strong cast of the interior.

Figs. 11–13. Same to show the cyrtoceran stage and section, with its impressed zone.

Fig. 14.

Figs. 15–16. Nautilus pompilius to show the cyrtoceran stage with its impressed zone.

THE EGGS OF PITYOPHIS MELANOLEUCUS.

BY J. PERCY MOORE.

In the absence of any complete published account of the breeding habits of the pine snake, the following notes may interest some of the readers of the NATURALIST. The material which furnished the data for this account was collected on Aug. 3, 1892, at Formosa Bog, Cape May Co., N. J., by a party of students from the Sea Isle City Marine Laboratory, who, under the guidance of Dr. J. M. Macfarlane, were engaged in botanical investigation of the region. The nest was brought to their attention through the courtesy of Mr. Peter Hoff, one of those rare genuises of the woods whom it is the pleasure and profit of the naturalist to meet with now and then in his wanderings, and to whom our exploring parties were indebted for many kindnesses.

The snake which mothered the brood was a fine specimen of its kind, nearly six feet in length, and one of Mr. Hoff's most valued companions, for it was well-known to him as a regular habitué of his fields and barrens. At the time of oviposition, which occurred in the middle of May, Mr. Hoff saw the snake traverse the entire length (about 100 yards) of a field planted with squash and cucumber vines, pausing frequently to test the quality of the soil, which was of a loose sandy nature, with its snout. A spot was finally selected by the side of a row of plants, where the more tenacious character of the soil favored the construction of a nest. Excavation was begun by loosening the soil with the head, which was worked under the surface; and the loose earth thrown out. By alternately breaking the ground with the head, and brushing away the loosened soil with the tail, as Mr. Hoff stated, a tunnel was finally constructed of sufficient length to entirely conceal the snake. Within this tunnel it remained entirely hidden from view until oviposition was accomplished, when the entrance was closed and the locality deserted.

Mr. Philip P. Calvert, who was present at the excavation of the eggs, furnished me with facts relating to their position and surroundings. They occupied an enlargement of the tunnel 6–8 inches below the surface, where they were massed together in a single coherent cluster—the shells being very firmly cemented together wherever they came in contact. Ten eggs in all were found, three of which were detached from the mass in removal; the remaining seven are shown in Fig. 1 (from a sketch by Mr. v. Iterson, the laboratory artist), which I am able to reproduce here through the kindness of Dr. Ryder.

The eggs are of irregular ellipsoidal shapes, varying much in size and proportions, and exhibiting, as a result of the various pressures to which they have been subjected, irregular depressions and protuberances. In size they range from 50x37 mm. to 64x 45 mm., a long narrow egg measuring 61x35 mm., and a short broad one 60x44 mm. The average measurement of the seven is 59x41 mm., exhibiting a mean variation in length of 4 mm., and in breadth of 3 mm. The variation in size is due chiefly, if not solely, to the variable amount of yolk present.

In the hope of raising some of the young, several of the eggs were placed in a box of dampened sand and stood in a sunny spot: but on being opened after three weeks the embryos were dead, and development interrupted at the point that had been reached on Aug. 4, when I received the eggs.

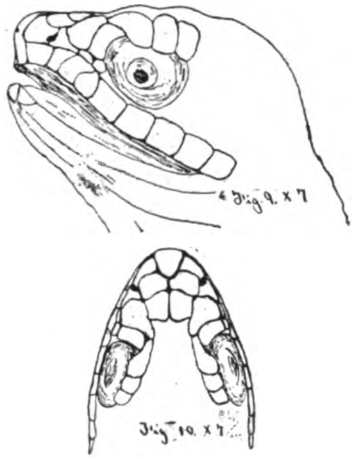
When fresh, the egg-shell was flexible and elastic, and of a very tough parchment-like character; and was very tensely and firmly stretched over its contents; but after a few days' exposure to evaporation, it became somewhat loose and wrinkled.

Its structure is interesting. Externally there is a thin incrustation of calcareous matter, which impregnates only the outer layers of the matted fibres of which the shell is mainly composed, and which appears to be present chiefly in the form of minute crystals and hexagonal plates. Over the greater part of the surface the calcareous crust is minutely cracked into elongated polygonal and irregularly lozenge-shaped areas, resembling the modern "crackle-ware" or the surface of old porcelain (Fig. 2). This appearance is particularly noticeable about the equator of the egg, where the long diameters of the areas are parallel to the long diameter of the egg, an arrangement due in part to a conformation of the areas to the curvatures of the surface, and in part to the structure of the fibrous shell. Calcareous deposit is most abundant at the poles of the eggs, and wherever two shells come in contact, they are firmly cemented together by the same material, all of which usually adheres as an elliptical area to one of the shells, when two thus joined are forcibly pulled apart (Fig. 1, a).

The shell is wonderfully tough for its thickness, which is only from $\frac{1}{5}$ – $\frac{1}{6}$ mm., made up, except for the superficial deposit of mineral matter, entirely of highly elastic fibres resembling in their disposition to curl when broken, and their neutral reaction to acetic acid, the yellow elastic connective tissue fibers. These vary somewhat in thickness, the largest having a diameter of $\frac{1}{200}$ mm., the smallest of $\frac{1}{400}$ mm., and the bulk of $\frac{1}{300}$ mm. They are extremely long, and I rarely found an end not artificially made. Naturally, they seem frequently to terminate in ovoidal or cylindrical swellings which are often sharply twisted, bent or folded. Unlike those which form the shell of bird's eggs, these fibres branched but very rarely, although short filamentous processes were not infrequently seen attached along their sides. Several fibres were traced under the microscope for an inch of their lengths without a single branching being detected. Two or more fibres frequently run side by side for long distances, and separating, give rise to a deceptive appearance of branching.

The most interesting fact to be noted with regard to the structure of the fibres is that they are tubular. Most, if not all of them, possess a distinct and continuous lumen, having a diameter of from $\frac{1}{3}$ to $\frac{1}{2}$ that of the entire fibre. This structure is well-shown in cross section (Fig. 3), and perhaps even more strikingly in specimens which, after having been allowed to dry, are mounted in glycerine, when the lumen becomes very conspicuous from the chain of minute air-bubbles which fill it and mark its course as a dark beaded line (Fig. 4).

The manner in which the egg-shell is built up out of these fibres is strikingly different from what obtains in the membrana putaminis of a bird's egg. Here the shell is built up of a number of distinct laminæ, in each of which the great bulk of the fibres have a generally straight and parallel direction obliquely around the egg, though their course is a regularly wavy one. They do not intricately cross and recross in every direction as in the chick's egg, but the fibres are generally disposed at angles of about 45° to the principal axis of the egg, the direction of the obliquity alternating in successive layers from one side to the other of this axis, so that fibres of successive laminæ are disposed at right angles to one another; those of alternate layers are parallel. The number of laminæ appears to be a matter of some constancy. Specimens from various parts of shells of three eggs were regularly separable into 9 or 10 distinct laminæ, which could be stripped off from the entire extent of pieces an inch square without exhibiting any signs of thinning out. I regard them, therefore, as being continuous over the entire shell. These layers are separable from one another with great ease, but it is noticeable in stripping them apart that a few fibres from one layer are always adherent to the adjacent layers, although there appears to be no extensive invasion of one layer by the fibres of another, except among the external ones. In any one lamina the sinuous course of the fibres causes a firm felting and interlocking among them (Figs. 5 and 6). The alternation of the direction of the fibres is shown in vertical section, but not very clearly, owing to the wavy courses which they take (Fig. 3).



Figs. 9–10.
Head of Foetal Pityophis.

The optical effects resulting from this structure are striking and peculiar when the entire series of separated layers are placed side by side in corresponding positions on a moistened slide. Those pieces in which the fibres are disposed at right angles to the rays of light coming in from a window appear, to an eye placed at the proper angle to catch the reflected light, of a beautiful, glistening, satiny white; while those the fibres of which lie parallel to the same rays, and present no reflecting surfaces, appear dull and lustreless. These appearances can be instantly changed from one set to another on revolving the slide over an angular distance of 90.°

A place of natural division, where separation is more readily effected than elsewhere occurs between the 3d and 4th inner layers. The three innermost ones then appear to constitute together the membrana putaminis. There is apparently no disposition toward the formation of a lenticular air-space; this being prevented by the high elasticity of the membranous shell, which causes it to continually contract over the contents as they shrink through evaporation. This contractility appears, however, to be limited, as noted above. Perhaps it is an adaptation to the varying conditions of moisture and drought to which these eggs, and others of their kind, are subjected.

The external six or seven layers are more closely bound together, and constitute the shell proper. The depressions in the surface of one layer resulting from the wavy course of the fibres, accommodate elevations on the surface of adjacent ones, thus greatly increasing the strength of the shell and making possible that partial invasion of one layer by the fibres of adjacent ones which is mentioned above, and which becomes more marked externally. These binding fibres may be seen to stretch and break as two layers are torn asunder.

The wavy structure also produces on the surface beneath the calcareous crust, and especially where two shells have been united, a peculiar pebbled appearance, like the pebbled binding of books. The outer layers in which the calcareous matter is deposited, have a less regular structure—the fibres being more irregularly interwoven; but when the mineral matter is removed with acid, the fibres readily disentangle and separate, being bound by no other cementing substance. Cement substance appears to be absent also from the other layers; which may be easily teased up, when the fibres float off freely in the mounting medium.

A rough analysis of the shell gives the following results.

Water	29·5 per cent.
Soluble mineral matter (almost entirely calcium carbonate)	16·6 per cent.
Organic matter	53·7 per cent.
	99·8

Well advanced embryos were found within the eggs. These must have been at least 10 or 11 weeks old. Those examined numbered equally males and females. They have an average length of 6¾ inches, the tail being $1\frac{1}{16}$ inches in a male and slightly less in a female specimen.

The embryos lie deeply embedded on one side of the abundant yolk, which envelops, and almost completely surrounds them, being packed thoroughly in among the folds; and in alcoholic specimens, requiring to be largely cut away to expose the full length of the embryo. The young snakes are arranged in somewhat irregular spiral coils, the larger folds of which are directed in the long diameter of the egg. There is no regularity in the arrangement of the folds; the spiral being sometimes wound in a left-handed, sometimes in a right-handed direction, figs. 7 and 8. Large clear albuminous masses are frequently embedded in the yolk.

The umbilical cord is short, measuring about ⅝ inch in length and $\frac{3}{32}$ inch in diameter. It leaves the body anywhere between ½ and 1 inch in front of the vent, between which points the somatic folds are entirely free from one another, while for a distance of an inch to an inch and one-half anterior to the umbilical cord they are only very feebly united. Beyond this point the gastrosteges are complete. These number in all 216 in one ♀ specimen examined—a number slightly less than the adult possesses. The anal plate is single, and the number of scales in a vertical row normal.

On the head the absence of certain plates present in the adult is noticeable. The scutes have not yet developed over the roof of the prominent brain case, nor in the post-ocular region. The frontal and parietal plates are not indicated at all, and the developed plates show some curious differences from the adult condition. The supraocular is clearly divided by two transverse grooves into three scutes, of which the anterior is largest. I suspect that the others may be really post-oculars which are here displaced by the prominent eyes. A small scute which may unite with the loreal underlies the preocular. Four postfrontals are present, the external pair being much the larger; but the single pair of prefrontals shows no indication of a division. The superior labials number 9, one more than in a specimen of the adult which I have compared. The inferior labials, except the first, are not developed, but the mental is well marked. The description of the head scutes is made from a single specimen, the only one which was well enough preserved to show them satisfactorily; figs. 9 and 10.

The egg tooth is indicated by a narrow fold which arises just below the ventral margin of the rostral scute. Rows of small papillæ on the jaws and palate represent the developing teeth. Their number and position are as in the adult.

In all male examples the paired penes were fully extruded immediately behind the anal plate; rudimentary penes were present in the females as a pair of low conical elevations in corresponding positions, fig. 12. In well preserved specimens each hemipenis is a somewhat compressed organ attached by a narrowed base. A constriction about the middle separates a basal from a somewhat more swollen terminal portion, which ends in a pair of rounded lobes, of which the dorsal is the larger and arises from a thickened rim which is seen to become continuous below with the more ventral lobe. On the external side of each hemipenis is a rather prominent lateral lobe.

Proximad to the median constriction the surface is dotted with numerous fine pointed projections, while the distal portion is covered by larger smoothly rounded papillæ. No papillæ whatever are present on the dorsal terminal lobe, which is quite smooth. Figs. 11–13.

EXPLANATION OF PLATES XIX, XX.

Pityophis melanoleucus.

Fig. 1—Cluster of seven eggs represented as they naturally cohere. a—point at which an eighth egg was attached. Natural size.

Fig. 2—Surface cracking of the calcareous crust—from an equatorial region. x 10.

Fig. 3—Vertical section of a small portion of the egg shell showing a small part of five laminæ. x 800.

Fig. 4—Several fibres of different sizes after being dried and mounted in glycerin. The lumens are filled with air. x 800.

Fig. 5—Surface view of a small portion of a lamina x 170.

Fig. 6—A few isolated fibres x 500.

Fig. 7–8—Two views of embryos in their natural positions on the yolk. Natural size.

Fig. 9—Left side of head of an embryo showing the scutes. x 7; p. 881.

Fig. 10—Dorsal view of the same x 7; p. 881.

Fig. 11—Anal plate and penes of a male x 8.

Fig. 12—Same region of a female. a—rudimentary penes. x 8.

Fig. 13—Lateral (external) view of a hemipenis x 7.

EDITORIALS.

—PUBLIC spirited citizens of Chicago have formed a corporation for the purpose of creating and sustaining a museum, which shall furnish to the public of the city an educational exhibition. It is an opportune time for such a project, as there is much in the Columbian Exhibition that can be obtained, which would serve as a nucleus round which a great museum may be collected. It is proposed that the museum shall be located near to Jackson Park and the University, and for the present the California building, one of the largest of this class in the park, is to be utilized for this purpose. The corporators have made an excellent beginning in appointing Prof. F. W. Putnam the managing director. Thus a scientific stamp is given to the enterprise at the outset, and its future value as an educational medium is secured. It is expected that Professor Putnam will organize the museum into departments, and will place over each a competent head, who will make the institution a medium of original research as well as of exhibition, as is the case with all the great museums of the world. It will thus become useful, not only to the general public, but to the University and to the Academy of Sciences. The corps of scientific experts connected with the museum and the University, would revive the Academy of Sciences, which has been dormant of latter times. This would give it a position in the country second to none west of the Allegheny Mountains, instead of being, as in late years, less productive than the societies of Cincinnati and St. Louis. If Chicago is the city she claims to be, she will do this, and more. She will have an Academy of Sciences which consists exclusively of scientific men. Only such a membership can give an Academy its proper position in the world, and prevent the organization from being a travesty of what it ought to be and might be.

—THE Postmaster General of the last administration, Mr. Wanamaker, proposed, it is said, to change the names of the post-offices throughout the country which are duplicates of those previously given to older offices. Perhaps Mr. Wanamaker found the task too onerous; at all events it has never been accomplished. It is hardly likely the present administration will undertake it, as it would savor too much of "paternalism" for democrats to tolerate, but as duplicate names have become an annoying evil, a future administration may make the needed reform. Nearly all the names of towns with which we are familiar in American geography have now been duplicated, generally several times. New cases appear in the papers continually. We recently noticed a half dozen or more stations on a branch of the Santa Fe R, R. system, whose names have been taken in toto from the time-table of the Pennsylvania R. R., west of Philadelphia. Many or all of these places are or will be post-offices. As the Santa Fe system is controlled in Boston we wonder at this piece of plagiarism (!), for Boston has never been noted for lack of originality. If this is possible from Boston, the stupidity of the rest of the country in the matter of names is easily understood! Nevertheless, Philadelphians (ignoring Kensington and Southwark), may protest in the names of Passyunk, Manayunk and Moyamensing, against such incapacity. There can be only one Chicago, one New York, one Philadelphia, etc., and those communities that duplicate these names simply efface themselves, as the French say. There is nothing easier than to find or invent new names, hence it is incomprehensible why American people should wish to call their homes Paris, Mexico or Berlin. In any case, if geography is to be taught in our public schools, or letters reach their destination, this maze of confusion must be corrected.

—The scheme of Mr. J. C. Bay to publish a yearly bibliography of American botany deserves every encouragement. He proposes an absolutely complete list of all papers upon American botany, accompanied by short abstracts of each, the whole to be published six months after the close of the year. We understand that a publisher has been found who is willing to undertake the publication, but the prompt issue of the volumes will doubtless prove a matter of some difficulty. Thus, of Just's Botanical "Jahresbericht," the volume for 1890 is completed in 1893, the same is true for the Zoological summary of the "Archiv. für Naturgesechihte," while the delay in the appearance of the English "Zoological Record" and the Naples Jahresbericht, though not quite so bad, is very aggravating to those who desire to keep fully abreast with the times.

—The question is often asked, Why do the American zoologists so universally neglect the American Association for the Advancement of Science? For many years scarcely an American publishing zoologist has been present at the meeting while the few papers on zoological subjects are in striking contrast to the interest shown in the sister science of botany. The reasons for this state of affairs are not readily stated.

Possibly most potent of all is the feeling that the association is far from being a representive of American science, and that it has degenerated into an annual junketing party. It is certain that the interests of science have been often sacrificed to excursions which interrupt the sessions, and which should be postponed to their close. Then, too, criticisms are often heard that it is run as a close corporation, that nominating boards are packed in order that certain persons may be put in office and that the expenses of the Association are far greater than they should be for the results achieved. There is, too, an inside history which can not be detailed which would explain a large portion of the indifference displayed. Before the Association can regain its influence it must undergo a complete transformation in its management and methods of administration. It must also present features which will attract the better workers of the country.

RECENT BOOKS AND PAMPHLETS.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1890. Washington, 1891.

Annual Report Canadian Geological Survey, 1888–89. Part D. Mackenzie Yukon Basins, Nine Sheets. Part N. Southern New Brunswick Superficial Geology, Three Sheets. Ottawa, 1891. From the Survey.

Annual Report of Curator of the Museum of Comparative Zoology at Harvard College for 1891–92. From Alexander Agassiz.

BAUR, G.—Bemerkungen über verschiedene Arten von Schildkröten. Separat-Abdruck aus dern Zool. Ang., No. 389, 1892.

——The Galapagos Islands. Extr. Proceeds. Am. Antiq. Soc., Oct., 1891.

——On the Morphology of the Skull in the Mosasauridæ. Extr. Journ. Morph., Vol. VII, No. 1, 1892. From the author.

BEECHER, C. E.—Revision of the Loop-Bearing Brachiopoda. The Development of *Terebratalia obsoleta.* Extr. Trans. Conn. Acad., Vol. IX, 1893. From the author.

BOETTGER, O.—Wissenschaftliche Ergebnisse der Reise Dr. Jean Valentine im Sommer, 1890. I. Kriechtiere der Kaukasusländer, Sonderabdruck aus Bericht über die Senckenbergische Naturf. Gesell. Frankfort a. M., 1892. From the author.

BREHM, A. G.—Thierleben: Die Kriechtiere und Lurche. Neubearbitet von Dr. O. Boettger und Dr. Pechuel-Loerche, Leipzig und Wien. 1892. From Dr. Boettger.

BROOKS, W. K.—The Embryology and Metamorphoris of the Macroura. Fourth Mem., Vol. V., Natl. Acad. Sci.

BRUMELL, H. P. H.—On the Geology of Natural Gas and Petroleum in Southwestern Ontario.——Notes on the Occurrence of Petroleum in Gaspé, Quebec. Extrs. Bull. Geol. Soc. Am., Vol. IV, 1893. From the author.

Bulletin No. 44, Massachusetts Agricultural Experiment Station, 1892.

Bulletin No. 30, U. S. Department of Agriculture, Division of Entomology. Reports and Observations and Experiments in the Practical work of the Division. From the Dept. Agric.

Climatology of North Carolina, from records of 1820–1892. From N. C. Exp. Station.

Congrès Internationaux d' Anthropologie et d' Archéologie préhistorique et de Zoologie. Materiaux réunis par le Comité d' organization des congrès concernant les expositions, les excursions et les rapports sur des questions touchant les congrès. Première Partie. Moscow, 1893.

DALL, W. H.—Tertiàry Mollusks of Florida. Extr. Trans. Wagn. Free Inst. Science, Vol. III, 1892. From the author.

DAVIS, J. W.—On the Fossil Fish-Remains of the Coal Measures of the British Islands. Part I. Pleuracanthidæ. Extr. Sci. Trans. Roy. Dub. Soc., Vol. IV (Series II), 1892. From the author.

DUMBLE, E. T.—Brown Coal and Lignite of Texas. Issued by the Geol. Surv. of Texas, 1892. From the author.

Dwight, T.—Observations on the Psoas parvus and pyramidalis. A Study in Variation. Extr. Proceeds. Am. Phil. Soc., 1893. From the author.

Earle, C.—On the Systematic Position of the Genus Protogonodon. Extr Am. Nat., 1893.

——Some Points on the Comparative Osteology of the Tapir. Extr. Sci., Vol. XXI, 1893. From the author.

Edson, C.—Hydrogen Peroxide in Contagious Diseases. Extr. the Doctor of Hygiene, April, 1893.

Ells, R. W.—On the Geology of Part of the Province of Quebec, South of the St. Lawrence. Extr. Trans. Roy. Soc. Canada, Sect. IV, 1891. From the author.

Eyerman, J.—Bibliography of North American Vertebrate Paleontology for the year 1892.——Bibliography of South American Vertebrate Paleontology, 1891–92. Extr. Am. Geol., June, 1893. From the author.

Foster, L. S.—The Published Writings of George Newbold Lawrence, 1844–1891. Bull. U. S. Nat. Mus., No. 40. Washington, 1892. From the Smithsonian Institution.

Gentry, T. G.—Family Names from the Irish, Anglo-Saxon, Anglo-Norman, and Scotch, Considered in Relation to their Etymology. Philadelphia, 1892. From the author.

Lamb, D. S.—The Meckel Diverticulum. Extr. Am. Journ. Med. Sci., 1893. From the author.

Leboucq, H.—Les Muscles Adductor du Pouce et du gros Orteil. Extr. Bull. Acad. Roy. Med., Belgique, 1893. From the author.

Lee, E.—Cholera: Its Prevention and Treatment. Extr. Chicago Clinical Rev., April, 1893.

Lee, T. G.—Biographical Notice of Joseph Leidy. Extr. Proceeds. Am. Acad. Arts and Sciences, Vol. XXVII. From the author.

Loomis, E.—Contributions to Meteorology. Second Memoir, Vol. V, Natl. Acad. Sci. From the Academy.

Lydekker, R.—Recent Advances in Knowledge of the Ichthyosaurian Reptiles. Extr. Nat. Sci. Vol. I, 1892. From the author.

McLaughlin, J. W.—Fermentation, Infection and Immunity. A new theory of these processes. Austin, Texas, 1892. From the author.

Memoirs of the National Academy of Sciences. Vol. V. Washington, 1891.

Mercerat, A.—Sobre la Presencia de Restos de Monos en el Eóceno de Patagonia. Estra. del. t. II de la Revista del Museo de la Plata. From the author.

Pohlman, J.—Duration of Life of the Nervous American. Extr. Med. News, March, 1893. From the author.

Reports on the Death Valley Expedition. A Biological Survey of Parts of California, Nevada, Arizona and Utah. Part II, North American Fauna, No. 7. Washington, 1893. From the U. S. Dept. Agric.

Report of the Trustees of the Australian Museum for the year 1891.

Ricks, R.—Natural History Object Lesson. A Manual for Teachers. Boston, 1891. From D. C. Heath & Co., Pub.

Ritter, W. E.—On the eyes, the integumentary sense papillae, and the integument of the San Diego Blind Fish (*Typhlogobius californiensis* Steindachner). Extr. Bull. Harv. Mus. Comparative Anat., Vol. XXIV, 1873. From Alexander Agassiz.

ROSENBERG, E.—Der Carpus der Schildkröten. Sonder-Abdruck aus Anat. Anz., 1892, Nr. 7 und 8. From the author.

SCHLOSSER, M.—Literaturbericht für Zoologie in Beziehung zur Anthropologie mit Einschluss der lebenden und fossilen Säugethiere für das Jahr, 1890. Archiv für Anthropologie Bd. XXI. From the author.

SEELEY, H. G.—Further Observations on Pariasaurus. Extr. Phil. Trans. Roy. Soc. London, Vol. CLXXXIII (1892), B. pp. 311–370. From the author.

SHARP, B.—Catalogue of the Crustaceans in the Museum of the Philadelphia Academy of Natural Sciences. Extr. Proceeds. Phila. Acad. Sci., 1893. From the author.

STEFANESCU, G.—On the Existence of the Dinotherium in Roumania. Extr. Bull. Geol. Soc. Am., Vol. III, 1891. From the author.

TALBOT, E. S.—A Study of the Degeneracy of the Jaws of the Human Race. Phila., 1892. From the authors.

WALCOTT, C. D.—The North American Continent during Cambrian Time. Extr. Twelfth Annual Report of the Director U. S. Geol. Surv. Washington, 1892. From the U. S. Geol. Surv.

WINCHELL, N. H. AND C. SCHUCHERT—The Lower Silurian Brachiopoda of Minnesota. Sponges, Graptolites and Corals from the Lower Silurian of Minnesota. Extrs. Vol. III, Final Rept. Minnesota Geol. Surv. June 6, 1893. From Mr. N. H. Winchell.

WRIGHT, G. F.—Evidences of Glacial Man in Ohio. Extr. Pop. Sci. Monthly, May, 1893. Mr. Holmes' Criticism upon the Evidence of Glacial Man. Extr. Science, May, 1893. From the author.

WRIGHT, J. M.—Nature Readers No. 4. Sea-side and Way-side. Boston, 1893. From D. C. Heath & Co., Pub.

RECENT LITERATURE.

Wiedersheim's Comparative Anatomy.[1]—Professor Robert Wiedersheim has given us two distinct manuals of Comparative Anatomy. One of these, the "Lehrbuch," although it has passed through three German editions, has not appeared in English, while the the other, the "Grundriss" was translated several years ago. This latter, the "Little Wiedersheim," has now appeared in a third edition, and all its claims to being the "little" work have disappeared. It is, in every respect, a new edition, as there is scarcely a page upon which new additions have not been made, while whole sections have been entirely rewritten. It now forms a mine of facts which no morphologist can ignore. Everywhere it seems up to date, the results of investigators in all parts of the world being incorporated into its pages. A work like this cannot be summarized in a few lines, and all we can do is to express our generally high appreciation of the work and to notice a few novelties introduced into the new edition. First of these is an explanation of the names of animals mentioned in the text with a reference to their place in the system, a feature of great value to the beginner. Thus we find "*Cephalaspidae*, armored ganoid from the Devonian and Upper Silurian formations (belongs with the oldest fishes)." Another innovation in this edition is the collection of the literature (as in the "Lehrbuch") in an appendix. In this latter part we could wish that the "running head" of the pages were sub-divided, so as to indicate at a glance the subject below; and, while making criticisms, we would say that were the reference letters in the legends of the cuts arranged in alphabetical order, it would be a great convenience. We learn, incidentally, that a new edition of the "Lehrbuch" is not soon to appear, but the "grundriss" work will be the vade mecum of all students of vertebrate morphology.

Mill's Diatomaceæ.[2]—The scope of this work is best shown by a statement of what it contains. The first chapter treats of what diatoms are and where they occur; the second of their structure; the third of their movements; the fourth of their classification; the fifth of reproduction; the sixth and seventh of collecting and mounting; the eighth of the study with the microscope; the ninth of microphotography, and the tenth consists of a large bibliography of diatom literature. Of the general treatment of the subject there is much to be desired. The chapter on microphotography is clear, and will doubtless prove of value to students, but the rest of the work is rather antiquated. Thus, the chapter on the movement of diatoms is based upon an article dated 1866, and is without a single reference to the later literature, the observations of Pfitzer, Schilberszky, etc., being ignored. The bibliography appears to be fairly complete, but the proof-reading of this portion is very bad. The typographical appearance of the book is good, but the publishers have committed thé not unusual fault of putting it upon much too heavy paper.

---

[1] R. Wiedersheim. Grundriss der vergleichenden Anatomie der Wirbelthiere. III Aufl. Jena, 1893, pp. xxx, 695.

[2] An introduction to the study of the Diatomaceæ, by Frederick Wm. Mills, with a bibliography by Julien Deby. 8 vo. pp. xix, 243, London, Iliffe & Son, Washington, The Microscopical Co., 1893.

Kennel's Zoology.[3]—In the past three or four years we have noticed not a few German text-books covering a greater or smaller portion of the field of zoology. This is the latest to appear on our table. In most respects it pleases us, in others it does not. Its author is at once too radical and too conservative. Thus he has completely done away with the old group of worms; he denies the validity of the group of Arthropods, and has assigned Amphioxus to the group of Tunicates, the latter group, in his linear arrangement, being sandwiched between the Brachiopods and Molluscs. To descend to details: The work is divided into two parts—general and special zoology. In the first we have, at the beginning, a discourse on what is a species followed by a brief account of evolution, and this in turn by the usual definitions of organic and inorganic, animals and plants, individuals, etc. Then follows the cell, protozoa, tissues and organs. In the special part we find the systematic zoology of the Metazoa with novelties enough. As already hinted, the old group of worms is dismembered, and the Arthropods are given short shrift with a few words like the following: "The Tracheata, which have previously been regarded as a sub-group of the class of Arthropoda, equivalent to the Crustacea, have, as it appears, aside from a series of external resemblances of form and extremities, no nearer relationships to the crabs." The failure to recognize the Chordates as a valid division seems also a questionable procedure. The 310 figures which illustrate the work have been mostly drawn by the author, either from nature or with the use of pre-existing figures, and are largely reproduced by some of the mechanical processes. Many of the diagrams are very instructive. Press-work and paper are good, as we always find them in German text-books.

---

[3] Lehrbuch der Zoologie von Dr. Julius Kennel. Stuttgart, Ferdinand Enke, 1893, 8vo, pp. xvi x 678.

General Notes.

GEOGRAPHY AND TRAVELS.

The State University of Iowa Biological Expedition to the West Indies and Florida Keys.—A somewhat novel departure along educational lines was successfully carried out during the past spring and summer under the auspices of the State University of Iowa.

A party consisting of three instructors and eighteen students chartered a 116-ton schooner and spent the months of May, June and July in biological work in the vicinity of the Bahamas, Cuba and the Florida Keys. The university furnished a very satisfactory equipment for a biological laboratory which was fitted up on board, a good working library of marine zoology, and also an equipment for dredging down to 250 fathoms, and a collecting outfit for marine work. All other expenses were met by the members of the party, the entire cost, including transportation from Iowa City to Baltimore and return, and board for the entire time, being only $200 for each person.

The first dredging was done on the Great Bahama Banks, where many interesting things were found. Next the party proceeded to the famous "Pentacrinus grounds" off Havana, where they succeeded in securing a quantity of the much-prized Crinoids at depths varying from 150 to 250 fathoms.

When it is remembered that this was done with a *sailing* vessel and *without steam* for hoisting, the members of the party will be pardoned for feeling somewhat elated over their success.

This was the first occasion on which iron rope has been used for dredging at such a depth with a sailing vessel. Many persons considered it impracticable, but Professor Alexander Agassiz thought it could be done. We found that the rope worked admirably and not a single fathom was lost during the three months of the cruise. Of course, no little credit is due the students, who worked manfully at the cranks of the hoisting machine day after day in the tropical heat.

The expedition was accorded many favors by the Cuban Government, and enjoyed the time spent at Havana and Bahia Honda, a port some forty miles to the westward. The local authorities at this latter place, however, seemed to regard the party as a filibustering expedition, in spite of the ladies on board. The shoal water collecting was

PLATE XX.

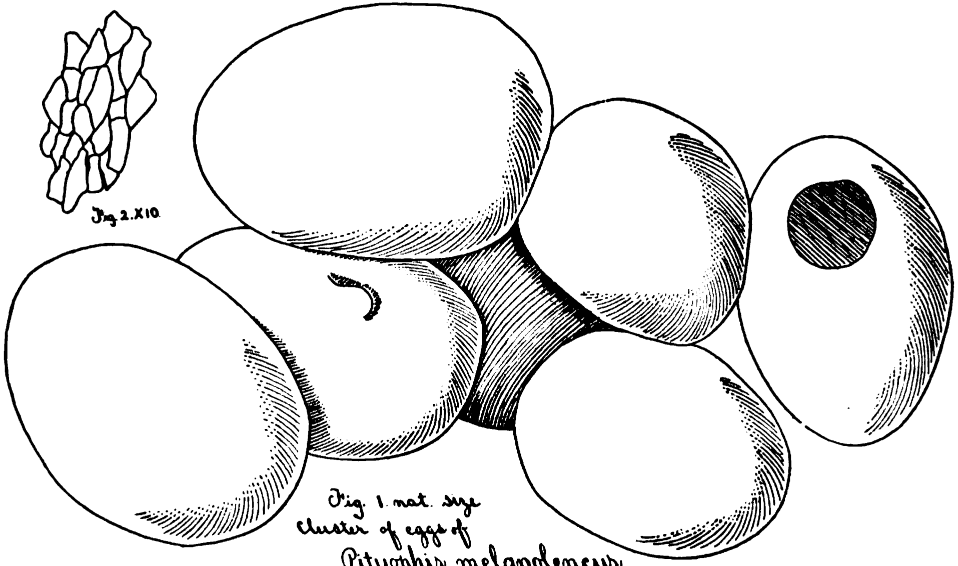


Fig. 2. X10

Fig. 1. nat. size
cluster of eggs of
Pituophis melanoleucus

excellent in this region, and a quantity of material was secured, although no one was allowed to go more than thirty yards inland from the water's edge.

From Bahia Honda the Iowans went to Key West, where they were not allowed to land on account of a yellow fever scare, but were ordered to quarantine at the Dry Tortugas, which was anything but a hardship, for a better ground for marine biological work would be hard to find. The quarantine officer, Dr. Robert Murry, was untiring in his courtesies, letting the members of the expedition have the full run of old Fort Jefferson, and, better yet, of the moat around it, which is, in effect, a grand aquarium such as delights the zoological heart.

On two occasions the whole party had the rare privilege of studying fully expanded Millipores, while living corals of many species were always at hand.

Two weeks were spent in dredging on the famous "Pourtales Plateau," between Sand and Sombrero Keys, at depths varying from seventy-five to two hundred and fifty fathoms. A great quantity of material was thus secured, including some characteristic deep-sea forms, such as Asthenosoma, calcareous sponges and old-fashioned corals.

Returning again to the Bahamas, the littoral and terrestrial faunas near Spanish Wells, Eleuthera, were very carefully explored, and a rich harvest secured. The shoal connecting Eleuthera with Little San Salvador was dredged, the most notable results being some particularly beautiful hydroids.

Thence a homeward passage of eight days concluded a cruise which will be remembered with delight by every member of the party, and which was as remarkable for the absence of any mishaps as for the educational and scientific results which will certainly accrue.

In addition to the specimens secured and notes taken by the party, a splendid series of photographs, taken principally by Instructor G. L. Howser, constitute the best of records of the cruise.

—C. C. Nutting.

GEOLOGY AND PALEONTOLOGY.

A New Plistocene Sabre-Tooth.—During the past summer I obtained for the museum of the Academy of Natural Sciences of Philadelphia, some fossil remains of vertebrata from the western part of Oklahoma. These consist chiefly of parts of a single skeleton with teeth of *Elephas primigenius columbii.* Mixed with these were found the bones of a sabre-tooth cat. A few of these only, together with some teeth, were saved. These include parts of three metacarpals, three phalanges of probably a single digit, and the head of the femur. The teeth include five incisors, two superior canines, and two molars, one of them the superior sectorial in perfect preservation. The animal had attained full size, but the epiphysis of the head of the femur is not coossified. The dimensions are equal to those of a lion, (*Uncia leo*), of the same age; and those of the superior sectorial are similar to those of the *Smilodon fatalis* Leidy, and a little smaller than those of the *S. neogæus* Lund, of South America.

Generic character. So far as preserved, the parts agree with those of the genus *Smilodon*, with one exception. This is that the superior sectorial tooth possesses no internal root, not even a rudiment. The protocone is wanting in Smilodon, but its corresponding root is present, but in this form the root also has disappeared, so that it may be regarded as presenting the last stage of specialization in the cats, a circumstance which is appropriate to its late appearance in time. I therefore suppose the species to represent a genus, to which I give the name of Dinobastis.

Specific characters. The canine teeth are large, with elongate compressed crowns, a little more convex on the external than the internal face. The cutting edges are finely serrate. The anterior edge differs from that of the *Smilodon neogæus* in that it turns inward toward the base of the crown, presenting inward. In the *S. neogæus* this edge is not incurved. The superior sectorial has a large anterior basal lobe and a rudiment of a second at its anterior base. It does not attain the importance of a lobe, as it does in the *S. fatalis.* The part of the crown anterior to the paracone forms about one-fourth of the longitudinal extent of the crown; in the *S. fatalis*, is forms about one-third. The paracone is prominent, and is strongly convex on the external face. The metacone has a nearly straight edge, and its external face displays a shallow vertical groove near the middle. The long diameter of its base is 1·5 as great as that of the paracone. The crowns of the external incisors are oblique, and slightly incurved; they have robust cutting edges, which are finely serrate, and no basal lobes. The incisors 1 and 2 have small conic lobes at the base of the crown, which are well separated from each other at their bases. Those of I. 1 are subequal, while the external of I. 2 is smaller than the internal, and nearer the base of the crown. The crowns proper of 1 and 2 are acutely conic with semicircular section, the posterior face being flat. The edges of I. 2 are feebly crenate; those of I. 1 are smooth.

The metacarpals represented are II, IV and V; of these No. IV is best preserved. It differs from that of the lion in the smaller transverse diameter of the head, and in the fact that the superior face of the diaclast[1] is nearly continuous with the proximal or unciform surface. The shaft is quite as robust as that of the lion. The shaft of the fifth metacarpal is on the contrary more slender. Its section is a triangle with convex limbs, and the obtuse apex external. The phalanges have forms and proportions similar to those of the fifth digit of the lion. The second phalange is a little shorter, and the margins display but small traces of the bases of the sheath, which has been broken off. Otherwise the ungual phalange resembles that of the lion.

Measurements.			mm.
Diameters crown I. 3	longitudinal,		22
	transverse,		13
Diameters crown superior canine	longitudinal,		80
	anteroposterior,		28
	transverse at base,		12
Diameters superior carnassial	anteroposterior,		35
	vertical	paracone,	18
		metacone,	13
Transverse diameter of head of femur,			40
Diameters head MC. IV,	anteroposterior, (restored),		22
	transverse,		15
Transverse diameter shaft MC. IV at middle,			16
Anteroposterior diameter shaft MC. IV at middle,			11
Length of phalange ? V 1,			38
" " " ? V 2,			24
" " " ? V 3,			22

This species, which I propose to call *Dinobastis serus*, increases the number of our Plistocene Felidæ to four. The three other species are *Smilodon fatalis* Leidy, *S. gracilis* Cope, and *Felis atrox* Leidy.

---

[1] For the explanation of this term see the Annual Report of the Geological Survey of Texas, 1892, Report on Vertebrate Paleontology of the Llano Estacado, p. 55.

MINERALOGY AND PETROGRAPHY.[1]

Anorthosites and Diabases from the Minnesota Shore of Lake Superior.—Along the middle stretch of the Minnesota shore of Lake Superior occur several exposures of a light-colored, coarse rock, consisting essentially of a basic plagioclase feldspar which, according to Lawson,[2] is sometimes bytownite; but more frequently anorthite or labradorite. This plagioclase is usually fresh and quite vitreous in appearance. It contains, as inclusions, small bleb-like masses of augite, plates and rods of the same mineral arranged parallel to the clinopinacoid, liquid enclosures, dust particles and small grains of hematite. In addition to the plagioclase there is also often present in the rock a small number of triangular augite plates between the feldspars. This rock which the author calls an "anorthosite," is found in knobs and bosses, and as boulders in the overlying Keweenawan eruptives. The rock is evidently an eruptive which is much older than the volcanic flows constituting a large proportion of the Keweenawan beds.

A second article by the same author[3] treats of the coarse diabase in "gabbro" sheets interpolated between the sedimentary beds of the Animikie. These are thought by the writer to be laccolitic in origin, i. e., to have been intruded between the sedimentaries after these had been solidified, and some of them even later than the time of deposition of the younger Keweenawan series. This conclusion is reached after a careful study of the contacts between the eruptives and the sedimentaries, which has brought to view the existence of contact phenomena at both the upper and lower surfaces of the diabase. The sheets of eruptives have been named the "Logan sills" in honor of Sir Wm. Logan, who was one of the pioneer geologists in the Lake Superior region.

The Volcanic Rocks of the Andes.—In a review of Küch's volcanic rocks of the Andes, Iddings[5] asserts that the chemical relations of the rocks studied indicate clearly that they all belong to the same consanguinous group as do the Cordilleran rocks of Mexico and the United States, and their nature indicates that the magma producing the Andes types has not yet become as highly differentiated as that which yielded the corresponding volcanics in North America.

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Geol. and Nat. Hist. Survey of Minn. Bull. No. 8.

[3] Ib. p. 24.

[4] Reiss and Stubel: Reisen in Sud-Amerika. Geologische Studien in der Republik Colombia, I. Petrographie, 1. Die Vulkanischen Gesteine bearbeitet von Richard Kuch, Berlin, 1892.

[5] Jour. of Geology. Vol. 1, p. 164.

Basalts and Trachytes from Gough's Island.—Pirsson[6] has examined some pebbles gathered from the beach of Gough's Island in the South Atlantic. He finds two of them consisting of basalt, and the others of trachyte glass and tuff. The glass is a pitchy-black mass, filled with small pores and marked here and there by a phenocryst of plagioclase. In thin sections it appears as a brown unaltered isotropic substance containing magnetite, apatite, olivine and saidine phenocysts and microlites of the last-named mineral. An analysis of the rock gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	Mgo	CaO	Na_2O	K_2O	H_2O	Total
61.22	.42	18.01	1.32	4.51	tr.	.44	1.88	6.49	5.93	.46	=100.68

Density = 2.210. The rock is thus shown to be unquestionably a trachyte in spite of the fact that it contains occasional olivines. The mineral evidently crystallized in an early stage of the rock's history, as all its grains have been subjected to magmatic resorption.

The Origin of the Gneisses of Heidelberg.—In gneisses occurring in the region northwest of Heidelberg, Osann[7] finds lenticular masses of graphitic and apatite schists, and therefore concludes that the gneisses are of sedimentary origin. The rocks do not possess the true gneissic foliation, since their feldspar, quartz, etc., do not show a sequence in origin, nor do their micas exhibit the pressure phenomena usually observed in the micas of other gneisses. Their structure is described as the "hornfels structure" which is characteristic of contact products. The graphitic schists consist principally of quartz, muscovite, graphite and flecks like the "Knoten" of contact rocks, which are formed by the aggregation of plates of a green micaceous substance. The apatite schist is composed of 55% apatite, 43% quartz, and 2% of graphite, tourmaline and rutile. An analysis gave: $CaO = 30.22$; $P_2O_5 = 22.86$; $F = 2.16$; Insol. = 43.52.

Petrographical News.—Retgers[8] communicates in a few brief notes the results of his examination of rocks collected in southern

---

[6] Amer. Jour. Sci., XLV, 1893, p. 380.

[7] Mitth. gross. Bad. geol. Landesanst. Bd II, p. 372.

[8] Neues Jahrb. f. Min , etc., 1893, I, p. 39.

Borneo. Actinolite, smaragdite, and glaucophane schists are the most interesting foliated rocks studied. They contain, in addition to their characteristic components: epidote, garnet and orthoclase, most of which show the effects of torsion and pressure. A quartzite is remarkable in that it contains andalusite, sillimanite, rutile, zircon and tourmaline. The eruptives mentioned by the author as existing in this portion of the island are porphyrites, diorite, gabbro, peridotite, serpentine and a pyroxenite (augite-fels).

Analysis of cretaceous lithographic limestones from various localities in America and Germany give such discordant results that Volney[9] thinks it impossible to judge from analyses alone as to the commercial and technical value of such rocks. The organic matter in the stones contains nitrogen and traces of iodine. It is believed to be the residue of cretaceous fossils, and to be the cause of the peculiarly fine precipitation of the calcareous substance of good stones.

The term "poikilite" has already been referred to in this note as descriptive of a rock-structure produced by the inclusion of many differently orientated particles of some mineral irregularly distributed within large plates of another mineral. This structure has been described by so many petrographers as occurring in so many different rocks that Williams[10] suggests its general use and proposes "micropoicelitic" as the term descriptive of the structure when observed microscopically.

Some excellent examples of cone-in-cone structure in a concretion from the coal measures of Wolverhampton, England, are noted by Cole[11] as exhibiting clearly the crystalline structure of these bodies and their identity in mode of origin with spherulitic growths.

The rocks occurring at Cingolina in the Euganean Hills, described by Tchichatcheff[12] a few years ago, have been reinvestigated by Graeff and Brauns,[13] who find augite-syenite and olivine-diabase cut by dykes of hornblende and augite andesites. The plagioclase of the latter rock includes a large mass of the rock's groundmass which has crystallized largely as plagioclase with the same orientation as a thin zone of the same substance surrounding the corroded host.

New Minerals—*Sundtite.*—In some specimens of a silver ore from a mine at Oururo in Bolivia, Brögger[14] finds masses and crystals of a dark tetrahedrite-like mineral associated with stibnite and pyrite. The dark mineral is steel-gray, with a black streak. Its hardness is 3–4 and density 5.5. Measurements of the crystals, some of which are 1 cm. long, indicated an orthorhombic symmetry. Twenty-one forms were observed, and from these the axial ratio $a : b : c = .6771 : 1 : .4458$ was determined. An analysis gave :

---

[9] Journ. Amer. Chem. Soc., XIV, No. 10.
[10] Jour. of Geol., Vol. 1, p. 176.
[11] Miner. Magazine, X, p. 136.
[12] Neues Jahrb f. Min., etc., 1884, II, p. 140.
[13] Ib., 1893, I, p 123.
[14] Zeits. F. Kryst, XXI, p. 193.

Cu	Ag	Fe	Sb	S		Total
1.49	11.81	6.58	45.03	35.89	=	100.80

which corresponds to the formula $(Ag_2.\ Cu_2.\ Fe)\ (SbS_3)_2$, or a salt of normal sulph-antimonic acid. Sundtite presents no analogies, either in composition or in its crystallographic characteristics, with other sulph-antimonates. Its nearest crystallographic relative is deschynite (RNb_2O_6). The new mineral is a commercially valuable ore of silver.

Melanostibian is another new mineral obtained by Igelström[15] from the celebrated manganese mine, Sjögrufvan, Grythyttan, Orebro, Sweden. It occurs as narrow veins in the dolomite, which is the bearer of all the ores of the mine. The mineral is in raven black, metallic-looking masses and tiny crystals, that are either tetragonal or orthorhombic. The streak of the mineral is cherry red, and its hardness 4. It is insoluble in dilute hydrochloric acid, but slowly dissolves in boiling acid. Its composition, corresponding to $6(Mn\ Fe)O\ Sb_2O_3$, was deduced from the following figures:

Sb_2O_3	FeO	MnO	CaO	MgO	H_2O		Total
37.50	27.30	29.62	1.97	1.03	1.06	=	98.48

Graphitite.—Upon treatment with nitric acid under certain conditions, the graphite from Ceylon, Norway and Canada yields an oxidation product that is different from the corresponding product obtained from the graphite of Fichtelgebirge, Siberia and Greenland. The materials of the two groups are therefore regarded by Luzi[16] as different, and as worthy of distinctive names. The mineral from the last-named localities is called graphitite.

American Minerals.—The *cookeite* of Paris and Hebron, Me., has been known for some time as a micaceous mineral closely related to the chlorites. In habit its plates are hexagonal, and are nearly always arranged in radial groups. These plates, according to Pen-

---

[15] Ib. p. 246.

[16] Ber. d. deutsch. chem. Ges., XXVI, p. 890.

field,[17] consist of an inner uniaxial hexagon surrounded by six segments extinguishing parallel to their edges and showing a biaxial interference figure. The mineral is monoclinic and is twinned like the clinochlor[18] from Texas, Pa. It is associated with quartz, lepidolite and tourmaline, and has probably been derived from the latter by alteration. An analysis of carefully selected material gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	Li_2O	H_2O	F	Total	O =F
34.00	45.06	.45	.04	.14	.19	4.02	14.96	.46	=99.32	—.19=99.13

This corresponds to the formula Li $[Al(OH)_2]_3$ $(SiO_3)_2$. The density of cookeite is 2.675.

The results of an examination of *zunyite* from the Charter Oak mine, at Red Mountain, Orange Co., Colo., and of *xenotime* from Cheyenne Mountain, El Paso Co., in the same State, have recently been communicated by Penfield.[19] The zunyite occurrence is five miles north of the original occurrence of the mineral first described by Hillebrand. The mineral is in little tetrahedrons scattered through an altered porphyrite. An analysis of these gave:

SiO_2	Al_2O_3	Fe_2O_3	Cl	F	H_2O	P_2O_5	CaO	Na_2O	Total	O=Cl&F
24.1	157.20	.61	2.62	5.81	11.12	.64	.11	.48	=102.70	—3.03=99.67

corresponding to $[Al(Cl.F.OH)_2]_6$ Al_2 $(SiO_4)_3$. Zunyite is found also in the mine as a white pulverulent mass resembling kaolin, but which consists of tiny octahedral crystals. The xenotime was from the tysonite locality described by Hidden[20] in 1885. It was a single fresh crystal of a brown color, implanted on a gangue of quartz and feldspar. Its density was found to be 5.106, and its composition: $P_2O_5 = 32.11$; Yt. Er = 67.78; Ign. = .18.

In the crystalline dolomite of Canaan, Ct., Hobbs[21] has discovered a rose-colored *talc*, that is noticeable for its large percentage of calcium and aluminium. Its analysis yielded:

SiO_2	Al_2O_3	MgO	CaO	FeO	MnO	H_2O	Total
61.48	3.04	22.54	4.19	.77	tr.	5.54	= 100.56

The density of the mineral is 2.86. It is optically negative, and its axial angle 2 E is 15° 30′.

In a recent Bulletin of the United States Geological Survey, Melville[22] has given the results of analysis of several American minerals as follows: *Natrolite* (I) from Magnet Cave, Ark.; a light-colored *tourmaline* (II) from Nevada Co., Cal.; *spessartite* (III) from Llano Co., Texas, and *bismuthinite* from Sinola, Mexico. Figures follow:

---

[17] Amer. Jour. Sci., XLV, 1893, p. 393.

[18] Ib. XLIV, p. 201.

[19] Ib. XLV, 1893, p. 396.

[20] Ib. XXIX, p. 249.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	F	B_2O_3
I	47.56	26.82		.20		.13	.09		15.40	9.63		
II	36.40	33.64	3.13			1.51	10.01	.12	2.49	3.53	.74	8.74
III	35.93	18.08		4.60	31.77	8.48	.69	.17		.36		

The spessartite contains also traces of TiO_2 and BaO.

Mineralogical News.—W. Ramsay[23] has discovered zonal growths of *epidote* substance in crystals of this mineral from the Sulzbachthal in Salzburg, Zöptan in Moravia, Arendal in Norway, Haddam, Conn., and from Traversella, Brosso and Ala in Piedmont. The different zones possess not only different colors, but they have also different extinction planes and diffent refractive indices, as do also different portions of the same zones.

Fragments and small crystals of carbon with all the physical properties of *carbonado* have been prepared by Moisson[24] upon dissolving carbon in iron and cooling the mass slowly under pressure.

Miscellaneous.—McMahon[25] has elaborated a systematic course in micro-chemical analysis based on the production of the sulphates and double sulphates of the elements. These salts are described as they appear on the object glass under the microscope, their habits are depicted and their constant peculiarities, if they possess any, are portrayed with some minuteness. The methods of analysis developed by the author will prove of great convenience to petrographers if they are found as practicable as they are declared to be.

The eighth volume of the mineral resources of the United States, edited by Dr. D. T. Day,[26] contains statistical data for the calendar year 1891. The total value of metallic products mined during this period amounts to over $181,000,000, and that of the non-metallic products over $241,000,000. The most notable article in the volume is an historical description of the past "twenty years of progress in the manufacture of iron and steel in the United States."

[21] Ib. XLV, 1893. p. 404.

[22] Bull. No. 90. U. S. Geol. Survey, p. 38.

[23] Neues. Jahrb. f. Min., etc., 1893, I, p. 111.

[24] Comptes Rendus, Feb. 6. Ref. in Nature, Feb. 16, 1893, p. 370.

[25] Miner. Magazine, X, p. 79.

[26] Mineral Resources of the U. S. Calendar year, 1891. Washington. Govt. Printing Office, 1893.

ENTOMOLOGY.[1]

Two Twig Galls on Populus Fremontei.—On the 25th of April, 1892, two galls were found on growing twigs of *Populus fremontei* in Las Cruces, New Mexico, and the following are descriptions of them.

Warted Gall.—Length and breadth, 22 mm., thickness 13 mm. Formed on side of twig, round, roughly and irregularly circular in outline, rather flattened, excrescentic or finely warted on the whole upper surface and edges or sides, involving about one-half of the body of the twig, the under surface next the twig covered by the thin spread bark expanded from the involved surface of the twig. Excrescentic portion of gall overlapping the smoother inferior portion on edges, brownish gray in color, the lower surface covered by the spread bark being pale greenish gray like the bark of the twig. Gall woody interiorly, the excrescentic portion filled with small cavities. On twig 5 to 6 mm. in diameter, but spread to 7 mm. at center of gall.

One specimen. Occupants unknown.

Tumor-like Gall.—Length, 12 mm.; width, about 5½ mm.; height (from twig), about 4 mm. Elongate, in shape something like a miniature mud-wasp cell, growing lengthwise on twig like an elongate tumor, one side broadly amalgamated with body of twig. Externally rather smooth, being wholly covered by the distended bark of the twig. Pale greenish gray in color, like the adjoining bark. Gall maker emerges by a circular exit hole 1.mm. in diameter, situated at the tip end of the gall, which is the more pointed end without reference to its being distal or proximal on the twig.

Three galls approximated on same twig, two being grown into each other side by side. A gall fly had escaped from each gall at some time previous to April 3, 1893. Two of the galls showed the exit hole conspicuous and open, but the third appeared to be still tenanted. On examination, however, it was found that the fly had escaped from this one also, but the circular flap of bark, which either the larva cuts on all sides but one before assuming the pupa state or else the adult cuts before it can emerge from the pupal cell, leaving a hinge-like portion intact, had sprung back in place perfectly closing and concealing the place of exit. From the cast pupal skins which remained in the cells, the occupant is apparently hymenopterous.

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

The larval gallery in one gall was 5 mm. long, by 1 mm. wide. In the other two galls there was nothing but the short terminal cell in which the pupa had lodged until it transformed, being just large enough for its accommodation, the larval gallery having evidently been lost and absorbed during the growth of the twig. In fact, the pressure of the growth was so great that the impression of the pupa was left in the walls of the cell.

—C. H. TYLER TOWNSEND.

A Woolly Leaf-gall on Oak near Grand Canon.—On the approach to the Grand Cañon, by the wagon road to Hance's, July 7, 1892, numerous specimens of a woolly or fuzzy-looking leaf gall were found on a low growth of a *Quercus* much resembling *alba*, at a point several miles from the rim of the cañon. This oak has been identified by Mr. F. V. Coville as *Q. gambelii.*

Gall.—Length, 5 to 9 mm.; greatest width, 3 to 5 mm.; height, 2 to 3 mm. Formed on upper side of leaf, but also showing below, irregularly oblong in outline, nearly always narrower at one end, always on one side of the midrib, extending usually from midrib to margin. Consisting simply of a portion of the leaf puckered up or elevated above the surrounding portion, both surfaces (upper and under) being equally and thickly clothed with very fine woolly but nearly straight hairs, standing straight out from the surface from which they sprung. Pubescence whitish with a greenish, or with a slightly yellowish tinge at least in dried specimens; apparently but an increased abnormal development or hypertrophy and multiplication of the naturally very short pubescence of the oak leaf, very thick and of equal length on upper and lower sides. The pubescence is ⅗ to ⅘ mm. long. The puckered portion of the leaf which is elevated and bears this pubescence is not thickened, but of same thickness as rest of the leaf, thus making the thickness of a vertical section of the gall about 1⅗ mm.

Described from 9 or 10 galls. There is no sign of the gall-maker, and it is hard to see what the larvæ of the latter would feed on unless they are microscopic. It seems certain, however, that this is a gall formed by some insect.

—C. H. TYLER TOWNSEND.

A Hymenopterous Gall on the Creosote Bush.—A peculiar spherical twig gall, much resembling in its formation the fruit of the buttonwood or plane-tree, has been frequently found on the creosote bushes (*Larrea mexicana*), on the mesa to the east of Las Cruces, New Mexico. All the galls of this species that have been found, however, have invariably been dried and dead ones. No green ones have been met with. The following description is drawn from old galls.

Gall.—Diameter, 18 to 27 mm. Rounded, more or less spherical in general shape, always formed around the twig which usually represents the axis of the gall; consisting of a rather hard central portion formed of resinous closely packed layers of very narrow leaflets radiating in all directions from the central point outward. The larvæ of the gall-maker live and transform in rather closely approximated cells on all sides, in this portion, with their ends all pointed to the center. Outside of this cell-containing portion, the very narrow leaflets, which nearer the center are closely packed into a resinous and nearly solid mass, are prolonged each one separately but more or less disposed in whorls, thickly covering the whole outer surface of the gall. These give the gall a coarsely fibrous appearance, as if it consisted of a knotted bunch of coarse fibers with the ends all sticking outward on the surface. The color of the dried galls is brown, varying from light to dark; that of the growing gall is doubtless green. The cells above mentioned, in which the gall occupants live, are rather elongate, pointed at the inner end, slightly flattened, about 1⅘ mm. in greatest width one way by 1⅕ mm. the other, and about 4 mm. long.

Described from three galls collected May 15, 1891. They are with hardly any doubt hymenopterous. Galls contain no remains of occupants. In plan of structure this gall greatly resembles that formed by a species of *Andricus* on leaves of scrub oak in the Organ Mountains. (See Can. Ent., 1892, p. 200).

—C. H. TYLER TOWNSEND.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Exposicion Historico Americano, Madrid, Spain, 1892. (*Continued from p.* 843).—I may be excused if I should give, in a most general manner, some intimation of the displays made by other countries of which we have no catalogue and no report. I should premise this by saying that this Exposition was the finest Pre-Historic or Proto-Historic or Archæologic display of American objects probably ever united under one roof. While we might be able to find more extensive displays from the United States than were here shown, and they might find in Mexico more extensive displays of Mexican antiquities than were at Madrid, and so on with regard to every country of America; but in this Exposition all these good things were brought together, and one had the opportunity, by passing from one hall to another to see the representatives of the good things of all countries. This made it the best thing of its kind ever produced.

Nicaragua adjoins the United States of America. A large proportion of its antiquities came from the Islands of Zapatera and Solentiname, in Lake Nicaragua. A leading object was a sample idol of stone from Zappatera similar to those in my department from the same locality. There were many objects in gold, not the same as those from Chiriqui or Antioquia, but bearing resemblance thereto. There were arrow- and spear-points of obsidian, the polished stone hatchets and similar objects showing them to belong to the Age of Polished Stone. They had quite a number of mealing stones—metates—some with legs and animal feet and animal heads, and altogether curiously-worked objects of art. They had a mass of pre-historic pottery, the shoe-shaped urn, the yellow and red decorated pottery, tripod bowls or dishes. Mr. Myorga, the head of the Commission, classed these as Aztecs, or as having a relation to the Aztec civilization.

Guatemala had an extensive display of antiquities. Stone idols mealing stones—metates—decorated with the heads of animals, stone tables, pestles, hammers, cores, chips, flakes, and arrow-and spear-points of obsidian. They had a fine display of pottery of all kinds and sorts, plain and decorated, of various sizes, and making as complete a series as possible. Their Spanish antiquities, or those brought to them or left there by the Conquistadores, were of considerable number and of great interest—swords, halberds, spikes, pieces of armor, clothing, etc., etc. They had not a few literary works of literary and historic value, ancient books in manuscript, olographs and autographs of their great men.

---

[1] This department is edited by Thomas Wilson, Smithsonian Institution, Washington, D. C.

The History of the Province of San Vicente Ferrer, a work by the Friar Francisco Ximenez, which, at whatever time it was commenced, seems to have been finished before 1720; another, "Isagoge Apologetico, General de las Indias." Photographic reproductions of the original volume of the history, by Bernard Diaz.

The Dominican Republic.—This little country was represented in greater part by historic than by prehistoric objects. Its cargo was composed principally of those objects which related to the Spanish occupation. One of principal interest was the First Cross. It was made of wood, erected in the first church that was established in the western world. Some of the stones of that construction, the plate, and similar objects, had greater value to the eyes of the Dominicans than others of greater scientific value.

In the display of Peru, the Argentine Republic and Uraguay, they exhibited more of the Inca civilization than of the Aztecs. The display was not formidable in numbers, nor were the objects of great size, but there was enough to assign them to the same scale of civilization as that which belonged to the Age of Polished Stone. There were objects of copper and gold.

Ecuador had an abundant collection of pottery of different forms, as of vases, dishes, platters, cups, figures of animals, and human representation, etc., of the usual form—the antique stone-work of the same description, polished stone hatchets, stone mortars, mealing stones, pestles, and copper implements, etc.

One of the peculiar objects presented in the Exposition at Madrid (and there were only three of them in the entire Exposition) was a Mummified human Head, the bones having all been removed, and it being reduced in size to about that of one sixth, skin and features all retained in proper proportion, the hair long and black, with a half-dozen strands of cord drawn through the lips.

Costa Rica was represented by her Minister, Senor Peralta, by Mr. Alfaro, Director of the National Museum at San José, and by Mr. Ferraz. Costa Rica had two large rooms assigned to her, and though one of the smallest countries, she filled and adorned with beauty and taste, the large space assigned to her. She displayed a considerable number of large stone objects, exceeding, in this regard, almost any other of her sister countries—stone objects in human form, others in animal form and apparently of natural size. The display of pottery was large and that shown was of a superior order. This collection was very extensive, and included every kind, both in shape and size, of pottery which belonged to the country. But that which was particularly interesting about Costa Rica was her unusually large display of gold objects. The greater part of these had never been shown in any public exhibition; they had been, for the most part, excavated and exhumed by Mr. Alfarro himself, or through his immediate exertions. I had no opportunity to examine them save in a slight and cursory manner; it would seem to be established that they were made, in addition to other supposed methods, by melting and casting. I had the privilege of taking some of them apart myself and choosing those pieces which had the greatest appearance of solder. I found no trace thereof, but it appeared impossible to have been done otherwise than by casting. I would not be understood to intimate that all of them were made thus, nor that none were made by soldering.

Sweden and Norway.—These two countries which occupy so close a relationship politically, were very properly installed together. Baron Nordenskiold was the Chief Commissioner, with Professor Bovallius for his aid. The center of the hall was occupied by a large glass case, the dimensions of which were to be counted by yards. It contained a model of the ship Vega, in which the Chief Commissioner made his celebrated discoveries and voyages in 1878–80. Arranged in the same case and making part of the display, were the various implements, tools, weapons, arms, domestic utensils, ornaments, dress, etc., of the people visited during the voyage. Associated with them were the Kyaks of Alaska, all the dress of the fishermen and hunters while on the water, and their arms, instruments and weapons.

One of the most interesting displays of the entire Exhibition was the ancient maps, the nucleus of which was the private collection of Baron Nordenskiold, and which he had been forming during many years past—atlases, maps, charts, globes, etc., were here without number—some of them the rarest and most valuable to be found. One corner of the hall was devoted to the discoveries and investigations of Mr. Gustavus Nordenskiold, the son of the Baron, among the Pueblos and Cliff-dwellings of Arizona and the Cañons of the San Juan and its tributaries. The volume containing a description of his discoveries, with all the necessary illustrations, is now in course of publication in Sweden, to be made in English as well as Swedish, and intended to be a rich and valuable volume.

Collections of Archæologic specimens by Dr. Bovallius during his visit of exploration in Nicaragua, were here displayed, as well as the same in the Antilles by Dr. Hjalmarson. Norway presented but a small display, the principal and most attractive item of which was a model of the great Viking ship which had been excavated from the tumulus of Godhav'n, now on display in the Archæologic Museum at Christiania, a smaller model of which is in the National Museum.

Denmark had a modest display, considering her Archæologic riches, but she was bound by the condition governing this, that, though but a novel and interesting departure, her display was confined almost exclusively to the discoveries made by the Danes through Iceland upon the Atlantic Coast, and so here was to be found a good representation of Greenland and Eskimo life from that country. Accompanying this Greenland display, were maps, charts, publications of every sort relating to the early discovery of America by the Norsemen. The maps, real or imaginary, of Massachusetts Bay and the coast of New Jersey, with the supposed voyages of the discoverers of the X and XI Century, at least in completeness. Whatever of relics that could be gathered were here displayed, and, altogether, it was the most satisfactory argument in favor of the discovery of America anterior to Columbus that has ever been made.

Germany.—The German representative was Dr. Ed. Seler, and he presented, in the hall allotted to him, the riches of the German Museum as they have been gathered during the many enterprising voyages of scientific investigation which his country has started throughout the Western Continent. Dr. Seler's investigations and discoveries in Guatemala, Honduras and the Mosquito Coast were here exhibited the form of a plaster or pulp reproduction of a score or more great Aboriginal monuments of those countries, so strange and wonderful, so little known. The investigations of Reiss and Stübel in Peru and representatives of the great collection made by them—first, of painted and decorated pottery, and second, of the polochromatic textile fabrics, was much to be admired.

United States of Colombia.—This country had but a small display. It was visited by me two or three times, each time with increased interest. Although I saw other objects during my first visit, my attention was soon attracted to the display of gold objects which this country possesses from the interior Province of Antioquia.

The National Museum possesses 20 or 30 of these gold specimens of this country, and feels that it already possesses a sufficient number and must decline to increase that number by purchase. Imagine my surprise to see in the display of this little country, sloping shelves, three or four feet wide, covered with black velvet, running along an entire side of the room, however, within glass cases which were abundantly guarded, and dotted over this black velvet were gold objects to be counted by the hundred—how many there were, I do not know. There were parts of two collections, one of which cost in Colombia, $75,000, and the other, that of Don Restrepo, who was present representing his country at Madrid, which cost $30,000. I, as Curator of my Department, had selected my little display of gold ornaments and taken them to Madrid, intending them for exhibition, but when I saw this magnificent and glittering display of prehistoric gold ornaments from this little country, I decided I could never put mine on display, and, upon preparing for my return, carefully packed them up and brought them home with me, and they are now displayed in their usual place in my department of the Museum.

Mexico.—She is our neighbor at home and she was our neighbor at the Exposition. She occupied about the same number of rooms as we did. While she had more objects, they were smaller and did not take so much space. I give the nearest sketch of some of the objects presented by Mexico, principally from memory: Models and reproductions in plaster, paper or staff of several of the principal monuments of their country. All that we have in our Museum of the Abadiano and Lorillard Collections were thus represented, if I may except the Calendar Stone, which unfortunately met with an accident well provided against, but which wrought its destruction. The monument was natural size, the same as we have in our museum, and was made of paper pulp; to guarantee safe carriage it had been hermetically sealed and soldered in a case of sheet lead, and this, with the necessary protecting straw, etc., was, in its turn, placed in a wooden box. It was brought by ship and landed at Santander. The attempt to bring it down through Spain by car, proved it to be too large to pass through tunnels and similar narrow places, and it therefore had to be brought by wagon. At some part of the voyage it was necessary to move or change the object, and for that purpose wooden strips had been nailed along the sides of the case to be used as handles. When placed on the wagon for transportation, these strips were pulled off and the nails by which they had been fastened, pulled out, leaving nail-holes upward and exposed to the weather. It rained upon the load nearly every day of the transport across the mountains, and enough water trickled through these nail-holes to dampen, then wet, and finally destroy the paper pulp of which the model was made, and when it was opened in the palace, it had been resolved into its original pulpy condition. The Stone of Sacrifice, the God of Silence, Teoyoamiqui and all the rest came through in safety. The Mexican section displayed models in wood, of several of their antique monuments, and sometimes the country around them on a reduced scale. The Aztec town of Zempoala, the Pyramid of Papaulta, and the Ruins of Xochicalco, were fine models. They occupied places in the center of each room. There were the usual amount of antique armor, arms and instruments, stones, ornamental utensils, and worked bone. There were a hundred or more of the T-shaped copper implements, quantities of pottery, etc. There was a fine series of plaster reproductions of the ancient inhabitants, showing individuals of both sexes and all ages, and attempting to reproduce the races or tribes from the different provinces. This reconstruction extended to their clothing and equipments, their arms, offensive and defensive, tombs, utensils, household and ceremonial, and the original adornments of gold and other reproductions. There was a fine series of maps, charts, and the originals of two Codicxes with paintings and sketches.

This display was intended at the time of its preparation in Mexico to be transported to Chicago for the World's Columbian Exposition, but the postponement of closing time at Madrid, and the necessity for its shipment *via* Havana prevented. Could this display have reached Chicago, Mexico would have appeared to much better advantage in this department.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Proceedings of the Botanical Club, of the Forty-second Meeting of the A. A. A. S., Madison, Wisconsin, August 16–22, 1893.—(Condensed from the Secretary's notes.)—Friday, Aug. 18.—The president and secretary being absent, the club was called to order by the vice-president, Professor W. A. Kellerman, and on motion W. T. Swingle was elected Secretary.

The committee on Nomenclature, continued from the last meeting, made the following report:

"To the Botanical Club of the A. A. A. S.: Your committee appointed at the Rochester meeting to prepare a check list of the flowering and fern plants of northeastern North America on the rules of nomenclature adopted by the club at that meeting would respecfully report:

"That the task assigned the committee has been performed, and the manuscript of the list is herewith presented, nearly complete for printing.

"The committee presents the following recommendations:

"1. The amendment of section III of the Rochester code of nomenclature by striking out all after the word 'retained.'

"This recommendation is based on the mature judgment of the committee after watching for a year the progress of the demand for a rule which shall permit no exception whatever, and effect the closest approximation to the immutability of the specific name.

"2. The publication of the check list for the club by the committee and the continuance of the committee for that purpose.

"3. That the form and the time of publication be referred to the committee with power to act.

"4. That the general sequence of the natural orders as taken up in Engler and Prantl's "Natürlichen Pflanzenfamilien" be adopted.

"5. That in determining the name of a genus or species to which two or more names have been given by an author in the same volume or on the same page of a volume, priority of place shall decide.

"6. That in the elevation of a plant originally described as a variety to a species, or the reduction of a described species to a variety, the original name shall in all cases be retained."

On motion the recommendations were taken up in order for discussion and action. The first recommendation was adopted after some discussion. On motion the consideration of the second recommendation was postponed until after the others were disposed of.

On motion the third recommendation was also postponed.

On motion the fourth recommendation was adopted unanimously.

On motion the fifth recommendation was amended to read "That in determining the name of a genus or species to which two or more names have been given by an author in the same volume or on the same page of a volume, precedence shall decide. On motion it was adopted as amended.

The sixth recommendation was discussed some time but was not brought to a vote before the club adjourned until Monday.

Monday, Aug. 21.—On motion the chair was authorized to appoint a committee of two to nominate officers for the next meeting. Prof. A. S. Hitchcock and Dr. Erwin F. Smith were placed on this committee.

On motion the remaining portions of the report of the committee on nomenclature were referred back to the committee with instructions to report Tuesday morning.

The report of the treasurer was then read, showing a deficit of $6.16. This deficit was liquidated by voluntary contributions.

The following papers were read:

Mrs. E. G. Britton, "The genus Bruchia in North America, with description of one new species." Mrs. E. G. Britton, "The necessity of seeing types." Prof. A. S. Hitchcock, "*Ampelopsis quinquefolia* var. *vitacea* Knerr." Dr. J. C. Arthur, "Exhibition of a centrifugal machine." The instrument is a new one devised by the author, costing much less than those made in Germany. Mr. T. C. McDougal, "Intertwining of tendrils." Mrs. E. G. Britton, "Jaeger's Adumbratio, and herbarium of mosses." The whole moss herbarium of Jaeger on which the Adumbratio was founded has come into the possession of Columbia College. Dr. W. A. Kellerman, "Notes on the exploration of the flora of Ohio." Prof. A. S. Hitchcock, "Pollination of *Œnothera missuriensis* and *Pentstemon cobœa.*"

Dr. D. H. Campbell, "Prothallial stage of Ophioglossaceæ." Records finding during the present year what are with little question the prothallia of *Botrychium.* Dr. Erwin F. Smith, "The increasing prevalence of a root disease of stone fruits." Dr. C. E. Bessey, "The use of personal names in designating species." Objects to the abuse of this practice by botanists.

Tuesday, Aug. 22.—The following were elected officers for the next meeting:

President, Dr. D. H. Campbell, Leland Stanford Jr. University, Palo Alto, California; vice-president, Professor D. C. Eaton, Yale College, New Haven, Conn.; secretary-treasurer, W. T. Swingle, U. S. Sub-tropical Laboratory, Eustis, Florida.

The committee on nomenclature then reported that they had reconsidered all the remaining portions of the report which had been referred back to them, and were unable to bring in any other recommendations. On motion these remaining portions of the report were referred to the committe with power to act, and the committee was continued.

The committee appointed at the Rochester meeting to consider the feasibility of establishing an American Botanical Society presented a majority report adverse to forming such an organization at the present time and place. Prof. C. R. Barnes then presented a minority report favoring the project, and outlined a plan of organization, providing for a committee of twenty-five to constitute the charter members.

On motion the minority report was adopted by a vote of 21 to 10.

The committee of twenty-five is as follows: J. C. Arthur, Lafayette. Ind.; G. F. Atkinson, Ithaca, N. Y.; L. H. Bailey, Ithaca, N. Y.; C. R. Barnes, Madison, Wis.; C. E. Bessey, Lincoln, Nebr.; Mrs. E. C. Britton, New York, N. Y.; N. L. Britton, New York, N. Y.; D. H. Campbell, Palo Alto, Cal.; J. M. Coulter, Lake Forest, Ill.; F. V. Coville, Washington, D. C.; D. C. Eaton, New Haven, Conn.; W. G. Farlow, Cambridge, Mass.; E. L. Greene, Berkeley, Cal.; B. D. Halsted, New Brunswick, N. J.; Arthur Hollick, New York, N. Y.; Conway Macmillan, Minneapolis, Minn.; B. L. Robinson, Cambridge, Mass.; C. S. Sargent, Brookline, Mass.; F. L. Scribner, Knoxville, Tenn.; J. D. Smith, New York, N. Y.; Roland Thaxter, Cambridge, Mass.; Wm. Trelease, St. Louis, Mo.; L. M. Underwood, Greencastle, Ind.; L. F. Ward, Washington, D. C.; W. P. Wilson, Philadelphia, Pa. The reading of papers was then resumed as follows:

Dr. J. C. Arthur, "A self-registering auxanometer." A relatively inexpensive instrument devised by the author. Dr. B. D. Halsted, "A new Exobasidium on Andromeda." Dr. B. D. Halsted, "Phyllosticta following insect work." Dr. B. D. Halsted, "A white-smut new to America." Dr. B. D. Halsted, "A water-loving Ascomycete." Mr. W. T. Swingle, "A new palm from Florida." Mr. W. T. Swingle, "The southernmost botanical laboratory in the United States." Giving a short account of the Sub-tropical Laboratory of the Division of Vegetable Pathology, lately established at Eustis, Florida, by the U. S. Department of Agriculture. A. B. Seymour, "Synonymy of *Valsa* *stellulata* and its allies." A. B. Seymour, "A key to species of Cladonia." Mr. Seymour exhibited this key, the work of F. L. Sargent. S. A. Beach, "Some observations on black-knot."

For want of time the following papers were read by title: L. H. Bailey, "Sand-Dune weeds." W. W. Rowlee, "The propagation of *Ranunculus delphinifolius* by runners." E. J. Durand, "Some notes on the germination of the spores of *Enteridium rozeanum*." C. V. Riley, "Herbarium entomology." C. V. Riley, "Yucca pollination." B. T. Galloway, "Notes on 'hexenbesen' of Rubus." B. T. Galloway, "Some methods employed in the investigation of parasitic fungi and other organisms."

Upon motion two members were added to the committee on nomenclature. Dr. Wm. Trelease, and Dr. E. L. Greene were named.

The club then adjourned until the next meeting of the A. A. A. S. —Charles E. Bessey.

SCIENTIFIC NEWS.

Among the recent deaths we notice those of Leonard Blomefield, the veteran naturalist of Bath, England; George William Shrubsole of Chester, England, aged 66; Miss Anne Pratt, the author of "Flowering Plants and Ferns of Great Britain," aged 87; the geologists, D. Homfray and George Robert Vine; and Franz Kiaer, the bryologist of Christiania, Norway.

Many Americans will learn with regret of the recent death of Mr. George Brook. He was born at Huddersfield, England, in 1857, was trained in business in his father's cotton mills, but soon turned to science. His early work was done in an admirably equipped private laboratory at home where he maintained marine aquaria and studied the embryology of the Teleosts. In 1884 he became connected with the Scotch fishing board and in 1885 was appointed lecturer on embryology to the University of Edinburgh. Among his more important papers may be mentioned his "Challenger" memoir on the Antipatharia and his catalogue of the Madreporarian corals of the British Museum, one volume of which was issued just before his death, which occurred August 12, as the result of sunstroke.

Mr. James William Davis of Halifax, England, died July 21, 1893, at the age of 47. He is best known for his monographs on the fossil fishes, the results of studies carried on in moments snatched from the large business enterprises carried on by himself and his brother.

D. T. Macdougal, formerly assistant in the biological laboratories at Purdue University at Lafayette, Indiana, has been appointed instructor in plant physiology in the University of Minnesota.

Dartmouth College is to be congratulated in its call of Dr. William Patton to the newly established Chair of Biology.

Professor Dr. J. Sollas has been appointed petrologist to the geological survey of Ireland.

Dr. A. Dendy, well known for his researches on sponges, has been appointed Professor of Biology in Canterbury College, Christchurch, N. Z., and will enter upon his duties there, February 1, 1894.

Mr. E. Uline has been appointed Curator of the Herbarium in Lake Forest College, Lake Forest, Ill.

Maximilian von Hantken, the Hungarian geologist died last June. He was professor of Palæontology in the University of Buda Pesth and councilor of the Hungarian Ministry.

RECEIVED
DEC 2 1893

THE
AMERICAN NATURALIST

VOL. XXVII. November, 1893. 323

ON THE GENERA OF THE DIPNOI DIPNEUMONES.

By HOWARD AYERS.[1]

The Dipnoi are a group of piscine vertebrates, unusually interesting, alike to the morphologist, the paleontologist and the physiologist. Hitherto these animals have proved, in many respects, unsatisfactory objects of study, since the existing forms have been accessible to but few workers, and then only as more or less poorly-preserved alcoholic specimens. Only within the last few years has this condition of things changed so that quite recently our knowledge of this group has been enriched by many interesting and important additions to the morphology, physiology and the general biology of two of the members of the group representing the two commonly accepted genera.

The papers containing the results of the researches upon the living specimens of *Lepidosiren annectens* we owe to Professor J. Waldschmidt, who has worked out the Dipnoan brain from the comparative standpoint, and in histological detail, and to Professor W. N. Parker, who has studied in more or less detail almost all of the organs of the body except the skeletal and nervous systems. His study was directed to the solution of the numerous points left unsettled by previous workers who were less favored in the quality of their material, and not to a fundamental research into the nature and relationships of any of the organs of the body. Professor Parker has gone over the ground covered by my paper on the anatomy and physiology of the Dipnoi,[2] and has cleared up some of the things which I was unable to carefully study, owing to the fact that the only material accessible at that time consisted of store-bought alcoholic specimens, intended, without doubt, for museum collections. Hence, it not unfrequently happened that questions depending upon histological detail could not be satisfactorily or finally solved. On the other hand, Parker has arrived at some conclusions which I think are hardly justified in the present state of our knowledge, and it is to these matters that we will now confine our attention. In my Freiburg paper I suggested that it was hardly permissible to maintain two distinct genera of the Dipneumones, and I based my suggestion upon the lack of adequate structural differences between the forms commonly held to be generically distinct. I proposed on that account to use the name *Lepidosiren* instead of the name *Protopterus* for the African species, and I called attention to the great scarcity of the individuals of *Lepidosiren paradoxa* in museum collections.

---

[1] Director of the Lake Laboratory, Milwaukee, Wis.

My remarks, and more especially the adoption of the name *Lepidosiren* as the sole genus of the *Dipneumones* had the effect of calling out a reply from the late Professor Anton Schneider, of Breslau,[3] and also an article by Dr. George Baur,[4] of Chicago University.

Quite recently, Parker publishes his agreement with the conclusions of Schneider and Baur as far as the generic distinctness of the African form is concerned. It may be of interest to the uninitiated to know that none of the recent writers have ever seen a fragment of a *Lepidosiren paradoxa* from South America, and we all alike depend upon the published accounts of this creature's anatomy by Bischoff, Hyrtl, Klein, and a few others, all of whose investigations were made on two or, at the most, three animals, and some of the workers had at their disposal for study only the material which had already been dissected by their predecessors, e. g., Hyrtl. Their papers were published some years ago (in the 40s or 50s), and leave much to be desired when examined for the solution of the problems of to-day.

Schneider's paper was based upon original investigation of a considerable number of African mud-fish from several widely-separated localities, and his conclusions are that *Protopterus* is not only generically distinct from *Lepidosiren*, but that there are also two well-defined species of the African form, to be separated on account of the number of ribs, the presence or absence of the cartilaginous fin-rays and some other characters of no importance here. Baur's paper is an historical resumé of the main facts about *Lepidosiren paradoxa.* In general, however, the reasons which have been given for keeping *Protopterus* distinct from *Lepidosiren* may be concisely stated as follows:

1. The presence of 4 gill-holes in *Lepidosiren* and 5 in *Protopterus.*
2. The presence of a larger number of ribs in *Lepidosiren.*
3. The absence of fin-rays in *Lepidosiren* and their presence in *Protopterus.*
4. The absence of external gills in *Lepidosiren* and their presence in *Protopterus.*

I shall now endeavor to show that the critics of my suggestion of the generic identity of these two forms have failed to bring any proof that it is not entirely reasonable and highly probable, and by their own investigation have weakened their case by discovering facts which go to prove the close relationship of these animals.

THE GILLS.

All the writers on this subject have failed to see the important agreement between the gill structures of *Lepidosiren* and *Protopterus,* and have been led off to base important conclusions on a relatively unimportant point in their anatomy. The statement which Schneider and Baur base so much upon, viz.: that *Protopterus* has 5 gill-slits, while *Lepidosiren* has only 4, certainly looks important enough to give the advocates of a genus apiece for these creatures ample warrant for their conclusions; but when we examine the actual significance of this difference in the number of holes in the side of the neck, most if not all the value of this character is destroyed, for the number of functional gills is the same in both animals.[5] The facts are that both animals have 5 gill-bars, but only 2½ gills; that the first and second gill-clefts are in both forms devoid of a respiratory membrane or structures, although their secondary blood supply through the bronchial artery still persists. These two pair of gills are completely atrophied in both creatures physiologically since they no longer serve in respiration, and the denuded slits are subject to that variation which is the fate of all rudimentary organs. The first slit suffers most and is greatly reduced. In the two (or three?) specimens of *Lepidosiren* which have, up to date, been dissected, the edges of the slit seem to have grown together, while in *Protopterus*, though the slit is still open, it is very much reduced, being smaller than any of the other gill slits. I venture to say that no very large number of individuals of *Protopterus* have been examined with special reference to this point. However that may be, the coalescence of the walls of a degraded gill-slit is not a character of sufficient morphological importance to found a genus upon, except, perhaps, in the eyes of a confirmed genus builder.

In both forms neither the first nor second gill-bars bear any gill membranes, but both possess an hyoidean demibranch (opercular gill rudiment). This gill is composed of a single row of gill leaflets as in *Ceratodus*. The third and fourth gill bars are provided with a double row of gill leaflets, while on the fifth arch is found only a single row of leaflets, a condition not obtaining in any other *Dipnoan* or *Ganoid*.

When these animals were named, they were little known to science. If they had to be named as new discoveries to-day, and could both be studied together in so doing, most zoologists would include both animals in one genus, even if they did not group them as varieties of one species.

I wish to call the attention of those anatomists who would insist upon keeping *Lepidosiren* and *Protopterus* distinct upon the basis of the number of gill clefts left open irrespective of the fact that the number of functional gills is the same, to the fact that there are other fish with a variable number of gills which are considered by as good authority as Johannes Müller, to the extent of his knowledge of the case, to be *mere varieties* of *one species*. Müller found among the *Bdellostomæ* from the Cape of Good Hope, individuals with 6 pairs of gills, others with an extra gill added to one side of the body, and still others with 7 full pairs of gills.

I have ascertained that, taking all the *Bdellostomids* together, they form a series in which the gill variation runs between the minimum of 6 pairs and the maximum of 14 pairs, or a DIFFERENCE BETWEEN THE EXTREMES OF 8 PAIRS OF GILLS, AND YET ALL THESE INDIVIDUALS NOT ONLY BELONG TO THE SAME GENUS—THEY BELONG TO THE SAME SPECIES!

THE RIBS.

The number of ribs has been selected by Schneider as a character of *generic* as well as specific value. The possession of 56 ribs is held to be characteristic of *Lepidosiren parodoxa*. Considering the small number of individuals examined, this cannot justly be said to be a settled fact. Schneider's diagnosis of 30 ribs for *Protopterus amphibius*, and of 35 ribs for *P. annectens* as a safe specific character, is, to say the least, ill-chosen, for the reasons that the number of ribs varies in specimens from the same locality, which have no other distinguishing characters save another variable, viz.: the presence or absence of external gills, and for the further reason that some authors (Owen, loc. cit. p. 47) have counted at least 37 ribs in *P. annectens*. Schneider failed to define what structures he would have counted as ribs; but I assume he would admit all rib-like processes attached to the bare notochord between the pectoral and pelvic girdles as entitled to be named ribs irrespective of questions of homology. THE NUMBER OF SUCH PROCESSES IS INCONSTANT IN *Protopterus*, but the extremes of variation have not been definitely made out. The number probably varies with age, but this is not certain.

Parker[6] has shown that Schneider's second species of *Protopterus, P. amphibius* is a mistake. Schneider gives the Gambia as the habitat of this species. The distinctive characters separating this species from *annectens* are the presence of lateral cartilaginous rays in the fin membranes and only 30 ribs.

Schneider describes the fins of the *Protopterus* material which Peters brought from Quellimane as long and pointed, but flattened appendages. This was found to be true of the pectoral fin, the pelvic fin being thickened at its base. The cartilaginous axis of each fin bears on one side several cartilaginous rays which support the membranous border of the fin. This border is, in turn, stiffened by numerous horny filaments (horn-rays). This membrane is found on the ventral edge of the pectoral fin. Schneider found cartilaginous rays in *P. amphibius* only.

Parker states that his animals were from the Gambia, and that the specimens which he "examined for the purpose possess in the middle part of the fin, numerous cartilaginous parameres on each segment in both fins," which, according to Schneider, is one sure sign of *P. amphibius,* but Parker's animals also had 35 ribs, which is one of Schneider's marks of *P. annectens.* Parker concludes that there is possibly considerable variation in both these structures within the species, and this agrees with what Wiedersheim has previously found with respect to the FIN MEMBRANES, irrespective of their supporting structures.

EXTERNAL GILLS.

Owen,[7] McDonnell,[9] Schneider,[3] Wiedersheim,[14] Peters and Parker[6] describe or mention the existence of external gills in specimens of *Protopterus* from the different localities of Africa. Owen's observation has already been referred to. McDonnel simply states that he found three processes, rudimentary external gills the longest of which measurd 4‴.

Boas makes the following statements concerning the external gills of the African mud fish.

" Uber die sogenannten äusseren Kiemen von *Protopterus* müssen wir ein Wort sprechen. Die betreffenden Gebilde waren bei den zwei von mir untersuchten *Protopteri* sehr klein, offenbar ohne jegliche Funktion. NACH PETERS SIND SIE DAGEGEN BEI JUNGEN EXEMPLAREN STÄRKER ENTWICKELT. Ich glaube dass man diese organe . . . . am richtigsten, oder wahrscheinlichsten, in die Reihe der vielfachen accessorischen Athmungsorgane, die wir bei Fischen finden, stellt. Ich finde es ferner sehr zweifelhaft, ob sie etwas mit den äuseren kiemen von *Polypterus* gemein haben die anderen Ursprungs, anderen Baues ist und von anderun Blutgefässen versorgt wird."

The branchial blood-vessels, as described by Peters and Owen (for *Protopterus*), are very different structures.

Parker found external gills in all of the specimens examined by him, but his largest were still comparatively small animals. He quotes Peters as finding them on fish 2–3 feet long, and that in young specimens they are thinner, while in old specimens they are broader. Parker asserts that my statement that these gills are only present in young animals is certainly incorrect. Boas quotes Peters as above, which is not in harmony with Parker's use of Peters' words. The majority of writers on this point agree that they belong to small or young animals, as is the case with the gills of *Polypterus*, and Parker's material was not sufficient to add anything to the settlement of this question.

With reference to the food habits of *Lepidosiren annectens*, there is no longer any doubt as to its omnivorous tastes.

Professor Parker has shown that it may, at times, be cannibalistic, but he errs in supposing that I maintained that it had entirely changed its food habits. Starting from supposed carnivorous ancestors, I claimed that *Ceratodus* had become essentially herbivorous in its habits, while *Lepidosiren* had only partly modified its habits in this respect. On page 510 of my Freiburg paper, Professor Parker might have read: "Der Darm ist bei Ceratodus stärker verändert, als bei *Lepidosiren*, und diese Verschiedenheit correspondirt mit der Grösse der veränderung, die Function erfahren hat," and further, that "Das Futter des Ceratodus besteht gegenwärtig aus verschiedenen, kleinen Mollusken (reichliche Schale von Gasteropoden und Lamellibranchiaten fanden sich im Darme), Gras, Riethgras und Zahlreichen anderen Pflanzen stücken." And I further ascertained that while the plant remains were not masticated, the shells had all been crushed to fragments. Now, if *Ceratodus* eats animal food, and has been modified more than *Lepidosiren* in the direction of herbivorous diet, it follows that *Lepidosiren* is also partly carnivorous.

The quotation which Parker makes from my paper, referring to the breeding habits of the Dipnoi, applies to *Ceratodus* only, and not in any part to *Lepidosiren*, and the trouble arose in the transposition by the printer, of the reference number which occurs in my MS. after the word "Beobachtung," to the next line of the printed text. The transposition escaped correction in the proof. The authority for the statement is, to the best of my recollection, *The Zoologist*, 3d Ser. Vol. VII, 1884 (?).

After a study of the pectoral fins, to which Professor Parker devoted his special attention, he concluded that they do not serve the function of feelers. This conclusion is not well-grounded, for it rests upon the author's failure to find tactile SENSE ORGANS in the skin of the appendages. Our author remarks "that the nerve supply seems out of all proportion to the rudimentary muscles, and this fact renders the absence of sensory organs all the more surprising," and, on p. 124, "So far as I have been able to observe, *all* the sensory organs in connection with the epidermis have the form of the 'lateral-line organs' described above, and in this point therefore, as in many others, *Protopterus* resembles amphibians more than fishes," a conclusion which, will without doubt prove to be too lightly drawn, for from the knowledge which we possess of nerve endings in the skin of fishes, and the methods of demonstrating them, it should not be a very difficult matter to show that the large nerve supply is, in this instance, distributed to the epithelium of the pectoral appendages in its character of a sensory apparatus.

The nerve supply indicates that the brachial nerve must contain many sensory fibers. It is composed of the first three spinal nerves, the dorsal and ventral roots of the hypoglosal, and a branch of the vagus. There is every evidence that the appendage is a very sensitive tactile organ, and the nerve-end apparatus will be found by making a proper study of the skin.

Referring to the occurrence of taste-buds in the *Lepidosiren annectens,* Parker states that I have described somewhat similar organs on the palate of *Ceratodus.* As a matter of fact, the description I gave applied to both *Ceratodus* and *Protopterus,* though I figured the organs from *Ceratodus* alone. I am pleased to see that Parker is able to confirm my own observations in this respect.

Hyrtl states that the intestinal canal of *Lepidosiren paradoxa* is slightly S-haped in the horizontal plane.

In *Ceratodus forsterii* and *Lepidosiren annectens* I found there was no indication of curvatures in the horizontal plane; but Parker states that he finds the gut in *L. annectens* slightly curved (S-shaped) in the VERTICAL plane, and hence that my statement that the alimentary tract in the Dipnoi is strictly parallel with the notochord is incorrect.

Even Parker's observations show the correctness of my statement, while he says, on page 215, "The alimentary canal extends almost in a straight line from the mouth to the vent," making no mention of curves.

The sensory papilla which I found projecting as a finger-shaped process part way across the anterior narial opening in *L. annectens,* Parker was unable to detect. No histological examination was made of this papilla, but I judged it to be tactile in function and from its location to serve as a guard to the entrance of the nasal chamber.

Our author does not produce any evidence for the support of his change in the name of the URINARY BLADDER to that of the CLOACAL CÆCUM, and he adds nothing to our knowledge of either its structures or its functions, so that any comparison of this organ with the rectal gland of Elasmobranchs is entirely against the known morphological relations of the two organs. The rectal gland of Elasmobranchs is a diverticulum of the gut in close relation with the end of the spiral valve, while the urinary bladder of the Dipnoi is a pocket of the cloaca entirely foreign to the gut, since it lies outside of the rectal sphincter and in close relation with the openings of the kidney ducts.

With regard to the LYMPHOID ORGAN of the mid-gut, which was fully described in my paper, Parker thinks he has positive evidence that it is a spleen, and hence uses this designation throughout. The name was first applied to this structure by Klein. The term spleen in anatomy is used to designate a definite body of lymphoid tissue which is usually more or less closely connected with some part of the mid-gut, though it may lie in the mesentery far from the walls of the gut. The name is strictly morphological in its bearing, and does not carry with it the idea of specific and localized functions. So far as the mass forms a discrete body, the term spleen is appropriately applied to it, for it serves to definitely mark the mass, but when the mass is absent, or, in other words, when the tissue has other relations, e. g., as in the Dipnoi where it is inclosed WITHIN the wall of the gut, we not only do not gain in the accuracy of designation, but we detract from the definiteness of the name as applied to other forms.

In structure, these tissues are not to be distinguished from each other, and if the aggregation in the region of the mid-gut is to be called spleen, those in the hind-gut and fore-gut are likewise spleens. We avoid difficulties of nomenclature if we reserve the term spleen for a discrete mass of lymphoid tissue which lies in the mesentery outside of the walls of the midgut.

Professor Parker has done a great service in tracing out the extent of the pancreas which, in the Dipnoi, lies entirely within the walls of the gut between its two coats and which he has described in histological detail for the first time; but the discovery of the pancreas and its ducts was made by McDonnell in 1858. This investigator made observations on living material which was afterward used for dissections, and he clearly states that the pancreatic ducts empty into the midgut in company with the bile ducts. Melville added a note to McDonnell's paper to the effect that both spleen and pancreas were present in the organ which the latter called pancreas.

No one has yet pointed out the very great significance which the condition of the pancreas in *Lepidosiren* has from a comparative anatomical standpoint. It is by far the most primitive condition of the organ known for the VERTEBRATA, since it remains entirely within the intestinal wall lying between the mucous membrane, of which it is an outgrowth, and the muscular coat of the gut and it thus represents a very early stage in the ontogency of the organ as it is developed in other animals.

Professor Parker states that the spiral valve in *Lepidosiren annectens* makes 6 or 7 turns. I found in all the specimens studied, and the point was specially examined, that the number was uniformly eight.

Our author attributes the statement to me that *Lepidosiren* lacks a distinct muscular coat to its stomach, and that in the intestine the musculature is only slightly developed.

On page 491 of my "Beiträge" I state: "Sowohl bei *Ceratodus* als bei *Lepidosiren* sind die Wände des Vorderdarmes auffallend dünn. Bei der maceration traten zwei deutliche Lagen von Muskelzellen hervor. Sie repräsentiren die Längs- und die Ring muskulater der höheren Wirbelthiere und sind sehr ähnlich der Muskelelementen der Cyclostomen, etc."

The passage which Parker alighted upon to misconstrue by taking it away from its context, reads as follows: "Bei *Ceratodus* ist das *Magenende* veshältnissmässig viel weiter als bei *Lepidosiren* (italics inserted here). Eine deutliche Muskulatur fehlt, doch sind zahlreiche spindelförmige Muskelzellen durch das ganze Bindegewebe der submucosa zerstreut."

Parker states that he failed to find the lobulation of the kidneys in *Protopterus* as described by me for the older individuals. My observations were made on a specimen 42 cm. long. The lobules were well-marked, but not so numerous or so sharply defined as in *Ceratodus*. He concurs in my statement that the so-called male organs of writers previous to 1884, were, in all probability, only immature female organs. Parker describes the presence of two vibratile filaments in the spermatozoan of *Protopterus* and considers this condition unique among vertebrates. I have observed the same structure in ripe spermatozoan of *Rhinoptera bonasus*. My observations were made on July 13, 1889, at the Marine Biological Laboratory, and it was found that the apparently single-headed, double-tailed spermatozoan resolved itself into a simple, straight filament, possessing a thickened body in the middle with a tapering filament given off from either end of it. The only difference between the two ends of the central body of the sperm-cell was the presence of the nucleus at one end from which the longer filament was given off. During life, both of these filaments are spirally but loosely coiled about one another, and during progressive motion this arrangement gives rise to the appearance of a vibratile membrane spirally placed on the tail. On adding Perenyi's fluid to the sperm, the cells, one and all, flew out straight and rigid, and the refractive body (nucleus ?) became very distinct in each. I have observed this structure in other fish spermatozoa, but never so distinctly marked as in the cow-nosed skate. It is possible that the double tail of *Protopterus* will be found to be constructed after this plan.

Owing to the very great scarcity of specimens of *Lepidosiren paradoxa*, it may be of interest to many to have a list of the known examples with their present resting places.

The following is a table of all the South American specimens of *Lepidosiren* yet taken and recorded:

Specimen	Discovered by	Locality.	Size.	Condition.	Museum.
No. 1	Natterer	Borba on the R. Madeira, 1836.	3 ft. 9 in.	Dissected	Vienna
No. 2	Natterer	Villa Nova on the R. Madeira, 1836.	1 ft. 10 in.	Dissected	Vienna
No. 3	Unknown	Unknown, 1840.			Paris
No. 4	Castelnau	Ucayali River, 1847.		Dissected	Paris
No. 5	Dr J. Barbosa Rodriguez	Igrapé de Aterro, (Manáos), 1886.	in cm. 85, female	Whole	Florence, Italy.
No. 6	Rodriguez	Autaz, Madeira River, '87	in cm. 40	Whole	Florence, Italy.

The fifth specimen was a female with well-developed eggs, which was caught in August, 1886. It was 85 cm. in length, and 28 cm. in girth at thep ectoral appendages. The body is distinctly cylindrical in shape, but somewhat flattened on the abdominal surface where the scales are bigger, thicker and lighter in color. The tail is short and much compressed, and is provided with an irregularly-rounded caudal fin, which is not continued cephalad as a true median fin, but only as a slight keel to the middle of the back. The fin rays of the caudal portion are cartilaginous. The pectorals and pelvic appendages lack a membranous edging. The pectorals are slender and compressed, while the pelvic appendages are stouter and conical in shape.

The scales are disposed in longitudinal rows, 10 in each, and are of a dark brownish purple color, with distinct blotches except on the belly. The lateral line is double. The eyes are small and lie beneath the skin. The branchial openings are very narrow, and are protected by thick fleshy flaps. External gills are absent, and the internal gills cannot be seen through the deep and narrow branchial slit. The mouth has fleshy lips. The gill-clefts are four in number, the fourth being much reduced. The three free branchial arches are fringed with conical papillae. The cloacal opening lies 10 mm. to the left of the median ventral line.

The sixth specimen comes from the same hands, and is in the Florence Natural History Museum.

It is much to be desired that these well-preserved specimens may become the means of clearing up many points in our account of the anatomy of the Dipneumonous Dipnoi.

---

[2] Jenaische Zeitschrift Bd. XI, 1885.

[3] Schneider, A., Uber die Flosen der Dipnoi und die Systematik von *Lepidosiren* und *Protopterus*, Zoologischer Anzeiger, No. 231, 1886.

[4] Baur, G., *Lepidosiren paradoxa*. Zoologischer Jahrbücher, II, 1887.

[5] The following notes on the statements given by different authors may be of interest in this connection:

Wiedersheim (Lehrbuch, p. 608) says *Protopterus* has 6 gill-bars and 5 gill-slits, with three and one-half gills.

Owen (Comp. Anat.. p. 468–481, '82, '85, '86) gives the same number of gill-bars, but says that there are 2 biserial, and 1 uniserial gill, besides which there is the opercular gill attached to the membrane supported by the hyoid. That "three seemingly analogous filaments (i. e., analogous to the embryonic external gills of Elasmobranchs) are retained on each side for a longer period in *Lepidosiren annectens*, but lose their vascular and respiratory character before they are absorbed."

Parker gives (Trans. Roy. Irish. Acad., V. 30, pt. 3, p. 161) 5 gill-bars and 4 gill-clefts, exclusive of the spiracle or hyobranchial.

There is a difference of one gill-bar between Parker and all other observers. There is a further discrepancy among observers as to the number of gills. In the case of *Lepidosiren paradoxa*, Bischoff and Hyrtl disagree as to the number of hemibranchs, the former describing the same arrangement of gills for *paradoxa* as exists in *annectens*, but Hyrtl, who worked over the same specimens, says that the gill-plates are absent on the first and last arches, only a trace of them being observable on the fifth. Since Hyrtl studied the material after Bischoff had dissected it, it seems probable that these gill filaments, being tender in nature, were broken away during the previous study, leaving only the "fadenförmigen Zotchen" found by Hyrtl.

[6] Parker, W. N., Anat., Physiol. of *Protopterus*, Trans. Irish Acad., 1892.

[7] Owen, R., Comp. Anat. Vertebrates and Description of *Lepidosiren annectens* Trans. Linn. Soc., XVII.

[8] Giglioli, *Lepidosiren paradoxa*, Nature, 1892.

[9] McDonnel, Anatomy and Physiology of *Lepidosiren annectens*, 1854.

[10] Bischoff, Th. L., *Lepidosiren paradoxa*, Leipzig, 1840.

[11] Hyrtl, J., *Lepidosiren paradoxa*, 1845.

[12] Klein, Beiträge zur Anatomie d. *Lepidosiren annectens*, Jahrb. d. ver. f. Naturk. in Würt., 1864, XX.

[13] Burckhardt, R., Das Nervensystem der Dipnoern (*Protopterus annectens*) 1892.

[14] Wiedersheim Grundriss der vergl. Anat. 2te ed. 1893.

ANIMAL INTELLIGENCE.

By Jas. Weir, Jr., M. D.

"Intelligence is a conservative principle, and will always direct effort and use into lines which will be beneficial to its possessor."[1] This definition of intelligence is peculiarly applicable to the lower animals, inasmuch as it does not convey any idea of a purely intellectual operation of the mind. Every instance of ratiocination in the lower animals, has its origin in the fundamental principle of benefit to the animal evincing this faculty of reason. The words, reason and intelligence, are, in a measure, synonymous, for without intelligence, reason can not exist and *vice versa*—without reason there can be no intelligence. They are both psychic factors, dependent each upon the other. The lower animals do not evince a high degree of intelligence, yet high enough to lift the mental operation above the automatic and spontaneous action generally called —instinct. Instinct itself is, in a certain sense, a process of intelligence, though its immediate operations may not be due to reason. Instinct involves mental operations; if it did not it would simply be reflex action. It is heredity under a special name. The father transmits his mental peculiarities as well as his corporeal individualites to his son. The experiences of thousands of years leave their imprint on the succeeding generations until deductions and conclusions drawn from these experiences become in man, that psychic essence called mind. The lower animals pass through a like experience and arrive, each in his own sphere and degree, at a kindred mental destination.

Reflex action is simply muscular adaptation excited by appropriate stimulation without mental cognizance. Instinct has always a mental element; and the lowest animal that lives is no more governed by reflex action than is man himself. The action of a spider spinning her web, is just as voluntary and is as much under mental direction and control, as the action of a carpenter building a house. That the very lowest forms of animal life give evidences of intelligence can no longer be denied. A very common rotifer whose body is cup-shaped and whose tail is armed with forceps, has been seen to seize a larger specimen with its forceps and thus attach itself to its cup. The larger rotifer immediately swung itself violently about until it met a piece of weed, this it seized with its forceps and began "the most extraordinary movements which were obviously directed toward ridding itself of its encumbrance." This it finally succeeded in doing, and the entire scene was so like intelligent action that the observer concludes "so that if we were to depend upon appearances alone, this one observation would be sufficient to induce me to attribute conscious determination to these microscopical organisms."[2] Conscious determination and ratiocination is found in animals as low down in the scale of animal life as the Rhizopoda. *Aethalia* will confine themselves to the water in a watch-glass in which they are placed, but when the glass is placed on sawdust, they will leave the water and go to the dust—their natural habitat.[3] These rhizopoda are content to remain in the water, as long as there is no sawdust in their vicinity, but as soon as they recognize the sawdust *through the glass*, they crawl over the rim of the latter to get into a more pleasing abode. This is a wonderful example of conscious determination to be found in an organism so low in the scale of life. Once, while examining some fungal cells, Carter saw a still more wonderful instance of intelligence in a rhizopod. He noticed that one of the spore cells had ruptured and that grains of starch were escaping from the crevice. Suddenly an *actinophrys* came into the field of vision and proceeding to the ruptured cell seized a grain of starch and then retired to some distance. Presently it returned to the same cell and extracted another grain through the crevice. "All this was repeated several times showing that the *actinophrys* knew that those were nutritious grains, that they were contained in this cell,

---

[1] Cope: Origin of the Fittest, p. 40.

[2] Romanes: Animal Intelligence, p. 18.

[3] H. J. Carter: Annals of Natural History.

and that, although each time after incepting a grain it went away to some distance, it knew how to find its way back to the cell again which furnished this nutriment."[4] Oysters taken from a bank never uncovered by the sea, open their shells, lose the water within and soon die; but oysters kept in a reservoir and occasionally left uncovered, learn to keep their shells closed and live much longer when taken out of the water.[5] This is an act of intelligence due directly to experience without even the factor of heredity. It is an instance of almost immediate adaptation to surrounding circumstances One would not expect to find examples of animal intelligence in such a low order as the *Helicidæ*, yet several instances can be adduced where snails have not only shown ratiocination, but have also evinced love and affection.

A gentleman fixed a land-snail, with the mouth of the shell upward, in a chink of a rock. The animal protruded its foot to the utmost extent and, attaching it above, tried to pull the shell vertically in a straight line. Then it stretched its body to the right side, pulled, and failed to move the shell. It then stretched its foot to the left side, pulled with all its strength and released the shell. There were intervals of rest between these several attempts, during which, the snail remained quiescent.[6] Thus we see that it exerted force in three directions, never twice in the same direction, which fact proves conscious determination and no slight degree of intelligence. An observer, Mr. Lonsdale, placed two snails in a small and badly kept garden. One of them was weak and poorly nourished, the other strong and well. The strong one disappeared and was traced by its slimy track over a wall into a neighboring garden where there was plenty of food. Mr. Lonsdale thought that it had deserted its mate, but it subsequently appeared and conducted its comrade over the wall into the bountiful food supply of the neighboring garden. It seemed to coax and assist its feeble companion when it lingered on the way.[7] Here we see not only an example of memory and discrimination, but also of affection and solicitude. After the snail had made its voyage of discovery, with rare unselfishness and true affection, it remembered its sick mate and returned for it.

---

[4] Ibid.

[5] Dicquemase: Journal de Physique, Vol. XXVIII, p. 244.

[6] White: A Londoner's walk to Edinburgh, p. 155.

[7] Darwin: Descent of Man, pp. 262–3.

Beneath the pavement in front of my door, a wasp (*Vespa nigra*) has her nest. The entrance to this nest is at the bottom of a *sulcus* formed by two parallel bricks. I rolled a piece of paper into a compact wad and placed it between the bricks and over the entrance during her absence. When she returned she seized the paper with her jaws and forelegs and endeavored to pull it away. This was prevented by the interposition of the brick on which she stood. She then went to the other side and tried again. Here she failed for the same reason. She then descended into the little gully between the bricks and easily removed the wad. When she again left the nest, I replaced the paper, and on her return she went through the same performance as at first. Again I replaced it, but the *third time she went at once into the gully and removed the obstruction.* This she did three times in succession. Comment is hardly necessary. The evidences of memory and ratiocination are too patent to be denied. Some members of another family, distantly related to the *Helicidæ*, the limpets, show evidences of intelligence, inasmuch as they have a very accurate memory of direction. Limpets, when at rest, live at certain fixed domiciles. When hungry, they leave these homes in search of food, but invariably return to them as soon as they have satisfied their hunger. One very pointed instance of this homing sense is given by Hawkshaw, a most careful and exact observer. A limpet had made a clearing on a sea weed covered block of chalk. In the center of this clearing was a pedestal of flint which projected an inch or more. On the top of this flint pedestal the limpet had taken up its abode. The cleared space had several hollows where the animal could have easily sheltered itself, but it preferred to return to its exposed home after each of its excursions.[8]

Not many years ago, a French exhibitor with a trained company of fleas passed through the country. These insects had been taught to march and counter-march, to dance, to feign death, to pull miniature coaches, etc., etc. While this does not evince voluntary ratiocination, it shows that fleas think and are capable of receiving instruction. "When we consider the habits of ants, their social relations, their large communities, and elaborate habitations, their roadways, their possession of domestic animals, and even, in some cases, of slaves, it must be admitted that they have a fair claim to rank next to man in the scale of intelligence."[9]

---

[8] Hawkshaw: Journal Linn. Soc., Vol. XIV, p. 406.

When Lubbock says that the ant ranks next to man in the scale of intelligence he does not err. The superior intelligence of the ant has been recognized and commented on by man since the very inception of history. The wisest man of his day, King Solomon, uses the ant to point a moral. He considers her intelligence and industry worthy of emulation, and says to the sluggard: "Go to the ant, consider her ways and be wise." This one factor, intelligence, and the faculty of intercommunicating intelligently, makes a colony of ants a *perfect* society. Their social relations make it a model republic. Ants are true socialists; communists of an ideal type. Their's is a patriotism sublimely grand in its total self abnegation. The commonwealth is everything—individual weal is not considered. Man is susceptible to individual attachments which form the basis of his happiness. The affection of ants, on the contrary, is a patriotism that is extended to the whole community, "never distinguishing individuals, unless, as in the instance of the communal mother, connected with the furtherance of the common good."[10] Ants can undoubtedly communicate. A short while ago I crushed a pismire in the track usually taken by the members of a colony inhabiting the hollow of a beech tree standing in my yard. A soldier ant came along presently and, smelling the blood of his murdered companion, was seized with a panic terror, and rushed away into the nest. He shortly returned with thirteen companions and made a slow and careful reconnoissance of the dead body and its surroundings. Then all of them examined the corpse, and, having satisfied themselves that their sister was dead, returned to the nest. In a few moments a large worker-ant, accompanied by two soldier ants, came out and proceeding to the body, picked it up and carried it down the tree to the ground. They then went beneath the grass and I lost sight of them. Their every action seemed to me to be governed by an almost human intelligence. The discoverer of the murder hurried into town, gave the alarm, and, quickly gathering some of his companions, went out in search of the murderer. On discovering that their companion was dead and her slayer absent, they came back to town and sent out a burial party.

---

[9] Lubbock: Ants, Bees, and Wasps, p. 1.

[10] Kirby and Spence: Entomology—" Perfect Society."

The ant is the only animal except man, which has slaves and domestic animals. Their intelligence is so highly developed that they make a perfect success in rearing their cattle and in capturing their slaves. The cattle of the ants are of the order *Aphididæ.* The herdsmen of these aphidian cattle can be seen patroling the shrubs on which the aphides are grazing. On them devolves the care of the herds. They bring them out in the morning and carry them back at night. They gather the eggs of the aphides, carry them into a specially built nursery, attend them carefully until the young aphides are hatched out, and then carry them to the shrubs most liked by them for food. Some strange senses enable them to recognize one another—an ant of the same species, but coming from another nest, is immediately recognized as a stranger and at once attacked. If the eggs of one ant colony are hatched out in another of the same species, the young ants are at once known to be strangers and intruders. This far transcends our intelligence. What mother could recognize her infant if it were born in the dark and she had never seen it? Again, if the *larvæ* of ants are removed, hatched outside of the nest, and then returned, the ants at once recognize them as kinsmen and receive them into the nest.[11] That ants and bees do communicate intelligently is no longer denied. Their means of communication is not definitely known, but it is the opinion of most scientists that it is through their antennæ.

---

[11] Lubbock: Ants. Bees, and Wasps, p. 119, et. seq.

I once saw wonderful evidences of this power of intelligent communication while watching a battle between *Lasius niger* and *Lasius flavus*. The black ants were on a foray; the booty in question being a large herd of aphides owned by the yellow ants. The yellow ants had a commissariat department and an ambulance corps. I frequently saw them drop to the rear during the battle and partake of refreshments. Those slightly wounded were also attended to by the ambulance corps. The black ants were in light marching order, and had neither of these conveniences and necessary adjuncts. These ants seemed to be governed by a high order of intelligence in this battle. The yellow ants repeatedly sent back to their village for reinforcements and in this instance were victorious. They were not so fortunate, however, in a second battle I witnessed, a short time afterward. Their antagonists were of the same species as in the first battle, but from a different colony. In this second battle the yellow ants were all slain, and their herds of aphides carried off by their conquerors.

The bee ranks next to the ant in point of intelligence and I have witnessed numerous instances of ratiocination in these interesting little animals. My bee-house is built of brick, without windows and has only one small door. The hives are made of glass and covered with thick curtains of muslin. This renders observation very easy. On one occasion I noticed that from some cause, a comb had become detached and was in danger of falling to the floor. The bees had noticed this before it had become apparent to me, and had begun to provide against disaster. They rapidly built a broad, thick support of wax between the endangered comb and the one next to it, thus securing it firmly. They then reattached the detached comb securely to the roof of the hive. When this had been done, they took away the temporary support and used the wax elsewhere. When men see a wall out of plumb and in danger of falling, they use like methods to prevent disaster. De Fravière says that bees have a number of tones which they emit from the stigmata of thorax and abdomen and by which they communicate information.[12] When a bee arrives with important news she emits several shrill notes and taps a comrade with her antennæ ; this comrade passes the news to another, this to another and so on throughout the hive. If the news is pleasing all remains orderly, but if the news presages danger, great excitement arises. The news of danger is always carried first to the queen as the most important person in the community.[13] I have heard these tones and believe with De Fravière that bees communicate information in this way. The queen emits a tone which is different from those of the workers. When the queen makes a progress through the hive while laying eggs, she frequently emits this cry. As soon as the workers hear it, they bow their heads and remain quiescent for several seconds. Both ants and bees show great affection for their young. They feed and cleanse them and assist them in every way possible. The young ant is shown all of the devious pathways and corridors in the habitation by the older ants, and her first visit into the world is made with several chaperones.

There is a spider peculiar to this locality (Daviess Co., Ky.) which I have never seen elsewhere and which I have not seen described. This spider spins two webs; one is a trap set for the procurement of her food, the other is built for the gratification of an æsthetic feeling hardly to be expected in an animal so low in the scale of animal life. This latter web is generally spun in the angle formed by two walls, and always where the early morning sun can shine on it for several hours. Through the center of the web, reaching from one extremity of its long diameter to the other, the spider spins a ribbon of silk about an inch broad. This ribbon is very beautiful. The mesh is as closely woven as silk itself, and shines in the sunlight like a band of silver. As soon as the sunlight falls upon this web, the spider makes her appearance and walks slowly up and down her glittering roadway. She is not at all timid and I have watched her for hours at her strange performance. She irresistibly reminded me of some well dressed woman who was out for a morning walk. She never left this ribbon to secure food, though I tempted her frequently with insects. After an hour or two of promenading, she would leave this web and go to her trap-web, which is generally situated near her place of amusement. This she kept up day after day until the duties of maternity called her elsewhere. I have never seen the male. There is but one other instance in the animal kingdom where an animal builds a special place of amusement. That animal is the bower bird, of which mention will be made further on.

---

[12] Romanes: Animal Intelligence, p. 158.

[13] Ibid.

Curiosity is largely developed in birds. The blue jay is the most curious as well as the most voluble of all birds. I have been able to differentiate twenty-three distinct utterances in the language, if I may use the word, of the jay. On one occasion, I left a glass jar containing three newts, on a large block of sandstone in my front yard. It had not been there long before a jay flew down to examine it. One of the newts made a quick motion, and uttering a cry of surprise the jay flew to a tree overhead. He remained quiet for an instant, as if in profound thought. He then uttered his assembly call and birds of all kinds came hurriedly flying up in answer to it. In a few moments I noticed in the surroundings trees, jay-birds, wood-peckers, sap-suckers, cat birds, song sparrows, orioles, mocking-birds, blackbirds, pee-wees and flickers. They made a terrible outcry, but suddenly became silent, when the jay, which had called them together, flew down to the rock. Several of his most courageous brethren immediately followed him. He went up to the jar, and made a careful examination of it and its contents, all the while uttering a low querulous monologue. Suddenly he uttered three loud, peculiar cries and flew away. The assembly then dispersed. On another occasion I noticed a jay sitting silent and absorbed on the roof-tree of a grape arbor. He appeared to be watching something beneath him very intently. On focusing him in my glasses, I discovered that he was in a state of great excitement and trembling all over. I noticed the direction of his gaze and soon saw the object of his regard. A large male cat was stalking a hare and was just crouching to make his spring. He sprang at the hare, but his jump fell short, and the hare bounded away in safety. And then the jay-bird seemed to be fairly overcome with delight. He trounced himself up and down, screaming with sarcastic laughter. He seemed to be jeering and ridiculing the cat to his fullest extent, and the cat seemed to understand him. He dropped his tail and disappeared in the bushes. The jay uttered one last note of derision and then flew away.

I once saw a very young cockerel come up behind an elderly hen and suddenly embrace her. When she discovered the youth of her assailant, her surprise, indignation and wrath was perfectly apparent and very laughable. Birds show a distinct individuality in nest building. No two pair of birds, even of the same species, build nests alike. To the casual observer they appear alike, but to the careful and experienced nest hunter, there is a marked originality in each nest. The general forms are the same, but each pair of architects leave the impress of individual genius on their particular nest. Three pairs of cardinals have been nesting in my garden for several years. If shown the nest, I can tell the pair of birds which built it. Wallace gives an instance of original nest building. Several pairs of bullfinches were taken to Australia when quite young. When they came to build their nests, they built them totally unlike those of the English bullfinch. They were long and round, like those of the oriole, only the entrance was at the bottom.[14] Some birds have developed æsthetic feeling and have a well marked love for the beautiful. Certain humming birds decorate their nests with beautiful pieces of lichen which they fasten on the outside. Feathers and various colored mosses are used for the same purpose.[15] Darwin asserts that the curious structures of the bower birds are pleasure houses, built by the birds for their own amusement and sports.[16] These bowers are not nests and are never continuously occupied by the birds. The nests are built in the jungle some distance from the bowers. The birds first build a platform of sticks and twigs, all of the knots and short twigs being turned toward the ground, thus giving a perfectly smooth floor. The bower, an oblong, oval structure, open at both ends, is then erected on this platform. This is also made of twigs, with all projections turned outward. The entrance to this bower is decorated with feathers, bones, shells, mosses and, in fact, any gaily colored article which the bird can procure. Evidences of intelligence in the higher orders of animals are so patent that even the most casual and superficial observer can see them. The cat, the horse, and the dog are nearer to man in his daily life than any other animal, and instances of their intelligence are very numerous.

---

[14] A. R. Wallace: Darwinism.

[15] Gould: Birds of Australia, Vol. I, p. 442.

[16] Darwin: Descent of Man, pp. 92, 406.

I present here a letter of Mr. J. Gibson Taylor, Owensboro, Ky., in which he relates a remarkable instance of ratiocination in a dog. "The dog, a water spaniel, had gone after a stick flung upon the ice of a pond about twenty feet distant from shore. The water was about five feet deep. The ice gave way. The dog went under the water several times in swimming about the enlarged space made by attempting to regain the surface of the ice, which gave way under his weight. He became thoroughly chilled by much confused swimming about in a circle, seeking some point at which the ice would bear his weight. I reached a limb to him and calling him by name shortly got his attention. He placed his paws upon the ice and seemed to listen intently as I extended the limb toward him, the ice, meanwhile, sinking under his weight as he looked at me. He caught the limb between his teeth and I assisted him by pulling him toward me upon the thicker ice inshore. Finally the ice became strong enough, about 15 feet from shore to sustain his weight. So, still with his teeth locked on the stick, I pulled him on the thicker ice and across the surface to the shore."

Here the dog, fully seeing his danger, and understanding the purport of the stick thrust out to him by his master, grasped it with his teeth, and held on until he was dragged into safety. Could man do more or reason better?

NOTES ON A COLLECTION OF MOLLUSKS FROM NORTH WESTERN LOUISIANA, AND HARRISON COUNTY, TEXAS.

BY T. WAYLAND VAUGHAN.

INTRODUCTORY REMARKS.

For several years, while resident in Louisiana, I busied myself in trying to bring together as good a local collection of the mollusks of the region as possible. During the past summer, while at work on the *Louisiana Geological Survey*, I continued my collecting, obtaining many specimens of land-shells, and a few fresh-water shells. Through the kindness of Mr. George Williamson, of Grand Cone, La., of Mr. O. B. Lewis, of Burk Place, and Messrs J. D. and J. E. Bailey, of Summerfield, coupled with my own efforts, it is likely that I have obtained more species from this section than anyone else. In view of this it seems highly probable that a few notes on this collection would be of passing interest to conchologists.

The largest part of the section that these remarks apply to is included between Ouachita River on the east, a line through Alexandria on the south, and the Texas and Arkansas lines, but I have transgressed these lines in speaking of a few specimens collected to the south of it in St. Landry Parish, and have included in the discussion, as the title denotes, Harrison County, Texas.

This list undoubtedly does not contain all of the species found in this region, for a few species originally described from this section have not been rediscovered. Undoubtedly, many more species of *Cyrenidæ*, *Pupidæ*, and other families will be found later. It is worthy of notice that the collecting of my friends and myself have brought to light no species of that large family *Pleuroceridæ* (*Strepomatidæ*) that is found in such large numbers in the southern States east of the Mississippi River. Some species of this family have been noted from Louisiana.

In the identification of my species I have to acknowledge gratefully the assistance of Messrs Wm. H. Dall, Chas. T. Simpson, Wm. A. Marsh A. A. Hinckley, R. E. Call, and Dr. V. Sterki. Either Mr. Simpson or Mr. Marsh, or both, have examined specimens of most of my *Unionidæ*, and Dr. V. Sterki has examined nearly all of my *Pupidæ*. It has been my good fortune to examine a good many of Lea's and Conrad's types at the Smithsonian Institution and at Philadelphia Academy of Natural Sciences, and I have been able to use the works found in the library of the Museum of Comparative Zoology at Harvard University, so that I think most, if not all, of the identifications are entirely trustworthy.

To my friends who have aided me in collecting, and to those who have helped in the matter of identification, my sincere thanks are extended. To Dr. Otto Lerch, Geologist of Louisiana, my thanks are especially due for enabling me to do collecting throughout the summer.

NOTES ON THE TOPOGRAPHY AND CLIMATE OF NORTHWEST LOUISIANA.

In order that the physical surroundings of the mollusks herein noted may be better understood, it appears to be justifiable that a few notes on the topography and climate of the section will be in place.

Probably there is no portion of the United States so misunderstood from a topographic standpoint as northwest Louisiana. Most of the people who visit the state go to New Orleans, which stands from eleven to forty feet above the sea level, in almost the flattest portion of the inhabitable part of the State, and immediately jump to the conclusion that the whole State a jungle of swamps and alligators. It is undeniable that a large portion of the State stands very little above mean tide-water, and that swamps and alligators do abound, but the northwestern portion of Louisiana is moderately hilly. The mean level of the country, from Shreveport to Monroe, is about 400 feet above the sea level, the elevation reaching on the hills from 150 to 300 feet higher. If one starts at Shrevesport, which is between 198 and 227 feet above the sea, and goes to Monroe, he will, after passing out of flat river bottom, cross a strip of level country about ten to fifteen miles wide, that forms a kind of shelf alongside the river bottom. After this one goes into the hills—topped with red-sandy clay, red-sandy or red-clay soils. These hills are the products of erosion out of a past plain, and Mr. L. C. Johnson compares them to the buttes of the west. Some of them rise rather abruptly, others gently; some attaining a height of from 80 to 150 feet above the general level of the hill lands. One hill called Leatherman's Mountain, is said by Mr. Johnson to reach an elevation of 700 feet, or about three hundred feet above the general level. The vegetation of these hill lands is mostly oaks, where the soil is not very sandy, but when much sand is present, the short-leaf pine (*Pinus mitis*) abounds.

As one proceeds south from Arcadia, at something like thirty miles distant from that place, the red sandy clays give place to pure white sands, that bear luxuriant forests of the long leaf pine (*Pinus palustris*), though as one nears Alexandria, which is 85 miles further south than Arcadia, the sand is somewhat redder, but still contains little or no clay. In the country whose surface is made up of these deep white sands, the lands wash badly, and hills rise very steeply to a height of 75 to 100 feet above their bases. These sandy hills are all clothed with an almost uninterrupted forest of that most majestic tree, the long leaf pine. It is absent only in the small "hollows" between the hills, and in the calcareous prairie lands.

Scattered through the southern part of Bienville Parish, through Winn, Grant, and Catahoula Parishes, are spots of calcareous lands, that are usually prairies of several acres in extent. These lands usually belong to the *Jackson* and *Vicksburg* horizons, though the spot of the lime-lands in northern Nachitoches Parish belongs to the *Claiborne*, *Ostrea sellæformis* being found there in great abundance. There is a hill of crystalline limestone near Winfield, La., that is *Cretaceous*. These lime-lands seem to present especially good conditions for the development of the land shells. By far the majority of the species of the land shells collected were found associated at one place or another with these calcareous lands. The need of lime for the growth of the shells easily accounts for this. *Bulimulus dealbatus* and *Helicina orbiculata* were found in abundance only on these soils.

All of the chief streams, large bayous, as well as rivers, flow in a general southerly direction. The two main streams are Red River and Ouachita River. "A dividing ridge, frequently noticeable only on closest inspection, runs almost central between the rivers, dividing the Ouachita and Red River system eastward and westward" (Lerch). Thus, certain of the bayous flow into Ouachita River, such as Cypress and Corney, and others flow into Red River, such as Dorcheat, Black Lake Bayou, Bayou Bodeau, etc. Bayou Pierre is on the west side of Red River.

One of the most noteworthy things about these streams is that they are subject to great periodical overflows. Thus, in the summer of 1891, I remember rolling up my trousers to my knees and wading across Bayou Dorcheat, but in the spring of the following year, when Red River was so overflowed as to wash away much of the railroad track, steamboats took passengers down the Dorcheat and up Red River to Shreveport.

Another feature of Red River is the flat, basin-like reservoirs, called lakes, that are found on either side of it. In many cases it is impossible to find any banks to these lakes, so gradually does the land slope toward them. There is a stream always flowing through the middle of them, and, in consequence of an insufficient outlet, the water accumulates at the lower portion of the stream. The high water in these lakes is caused either by back-water from the river, or by a large amount of water being brought by the stream that opens into them.

The bottoms or beds of these lakes and bayous are usually very soft, and collecting is thus rendered abominable, it often being a continuous process of wallowing in the mud. Sometimes a firm foundation may be found to stand on, but it is the exception. In Red River one usually sinks waist-deep in the soft mud. The bottom of the smaller creeks is usually somewhat firm. The small creeks in the sandy hills of the long leaf pine region have beautiful, firm, white sand bottoms, and the water is so clear that the fishes can be seen darting hither and thither, even when they are of considerable depth.

As to climate, the following data taken from Dr. Otto Lerch's "Preliminary Report upon the Geology of the Hills of Louisiana, etc." (1892), may be of interest.

Mean Temperature at Shreveport, La., for each Month the past Twenty Years, from 1871 to 1890, inclusive.

Jan.	Feb.	Mar.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual mean.
45.8	51.5	58.1	66.1	73.3	79.9	82.7	81.5	74.8	65.4	54.2	49.5	65.2

The latest frost in the spring ranges from Feb. 14 to April 9; it usually occurs the latter part of March or within the first few days of April. The earliest frost ranges from October 7 to November 18—it usually comes toward the latter part of October. The highest temperature in the summer ranges from 91° F. to 107° F.; ordinarily it is between 98° F. and 104° F. In winter the temperature rarely falls below 12° F.

Total Precipitation at Shreveport, La. Average of each Month the past Twenty Years, from 1871 to 1890, inclusive.

Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual mean.
4.93	4.62	4.74	5.55	4.47	3.69	3.74	2.05	4.30	3.52	4.88	4.81	4.30

As one goes south and nearer the seashore from Shreveport, corresponding changes in the temperature, etc., take place.

LAND MOLLUSKS.

LIMACIDÆ.

ZONITES.

Zonites (*Hyalina*) *arboreus* Say, extremely abundant, being found under damp rubbish throughout the section.

Zonites (*Hyalina*) *indentatus* Say, is not so abundant as the preceding species, but is found almost everywhere the conditions of snail life are satisfied.

Zonites (*Hyalina*) *miniscułus* Binney, is found rather commonly throughout the section.

Zonites (*Conulus*) *Sterkii* Dall, was collected under damp leaves near Mt. Lebanon.

Zonites (*Conulus*) *fulvus* Draparnaud, is found in many places, but is not very abundant.

Zonites (*Mesomphix*) *lævigatus* Pfeiffer, is found in many localities, and was collected in abundance in trash found near branches and along the creek bottoms.

Zonites (*Mesomphix*) *demissus* Binn., was collected at several places in Bienville Parish, at Grand Cane, and on the calcareous prairies of Winn Parish. Not very abundant.

Zonites (*Mesomphix*) *intertextus* Binney, abundant under trash along creek bottoms. The specimens are usually more depressed than the figure in W. G. Binney's Bulletin 28 of the U. S. Nat. Mus., but the specimens collected in Red River bottom in Rapides Parish were quite as much elevated.

LIMAX.

Limax, sp. A species of *Limax*, that seems to be *L. campestris* Binney, was collected in the early part of 1891 abundantly around Mt. Lebanon after light showers. The extremely dry summer of '91 seemed to have almost exterminated them, so that after that spring I could not find any more specimens, and did not determine the species certainly.

Limax flavus Linn. was collected under some logs near the depot at Washington, St. Landry Parish.

PHILOMYCIDAE.

PHILOMYCUS.

Philomycus carolinensis Bosc. Abundant in damp places.

HELICIDÆ.

PATULA.

Patula alternata Say, abundant throughout the section.

Patula perspectiva Say, was collected at Columbia, near Rosefield, in Catahoula Parish, and near Ville Platte, in St. Landry Parish. Is not very abundant.

PUNCTUM.

Punctum pygmæum Draparnaud, near Mt. Lebanon. Rare. Dr. Sterki considered a specimen that I sent him this species.

HELICODISCUS.

Helicodiscus lineatus Say, found in many localities. Not very abundant.

POLYGYRA.

Polygyra leporina Gould, found in many localities in small numbers.

Polygyra texasiana Moricand, found near Tullos, La., in calcareous prairie, and in the Red River drift at Shreveport and Alexandria.

Polygyra dorfeuilliana Lea, abundant at Mt. Lebanon, and is found in many other places.

Polygyra espiloca Rav. A single specimen was collected on Catahoula Prairie, and some others were found near Ville Platte.

STENOTREMA.

Stenotrema monodon Rackett, var. *fraternum* Say, found in abundance throughout the section. The variation in size, and degree of compression of the spine is great.

Stenotrema labrosum Bland, calcareous prairie at Tullos, and in the Red River drift at Alexandria.

TRIODOPSIS.

Triodopsis inflecta Say, was collected in a good many places, but is not very abundant.

Triodopsis obstricta Say. I have collected specimens in the river drift at Alexandria and Shreveport. At Alexandria I also found some live specimens. Mr. Geo. Williamson has found the species rather abundant around Grand Cane.

Triodopsis vultuosa Gould, found abundantly around Mt. Lebanon, and in many other localities.

MESODON.

Mesodon thyroides Say. Both the more typical *thyroides* and Gould's variety *bucculentus* are abundant at many localities.

Mesodon albolabris Say. Some specimens, though somewhat small, for this species seem best placed when referred to it. Not abundant.

Mesodon divestus Gould. Grand Cane, La. These specimens do not fit anything else, and Mr. Harper, of Cincinnati, has so determined specimens sent him by Mr. Williamson. Since we are agreed independently, I feel safe in the identification.

BULIMULUS.

Bulimulus dealbatus Say, found by the thousands on the calcareous prairies of Winn and Catahoula Parishes. Mr. Lewis collected it around Burk Place, Bienville Parish.

PUPIDÆ.

STROBILA.

Strobila labyrinthica Say, abundant wherever there is damp trash.

PUPA.

Pupa curvidens Gould, Mt. Lebanon, La., and near Bienville, also from river drift at Alexandria.

Pupa pentodon Say, river drift at Alexandria.

Pupa milium Gould, river drift at Alexandria.

Pupa sp. Calcareous prairie lands, Winn Parish, La.

Pupa fallax Say, found in nearly every portion of the section. Often very abundant.

Pupa armifera Say, throughout the section, but not so abundant as *P. fallax.*

Pupa contracta Say, throughout the section. Abundant.

Pupa procera Gould, rather abundant on the calcareous prairie lands of Winn Parish, found also in the Red River drift at Alexandria.

VERTIGO.

Vertigo ovata Say, river drift at Alexandria.

SUCCINEIDÆ

SUCCINEA.

Succinea avara Say, Mt. Lebanon; calcareous prairie lands of Winn Parish. On these lime prairies dead specimens are found several inches beneath the surface of the ground. I imagine that they crawl into cracks in the ground during the dry summer months and are entombed.

Succinea grovesnorii Lea, Jonesville, Texas; Boyce, La., and Bayou Pierre. These specimens are obtained in the damp rubbish immediately above the water's edge. They seem almost semi-aquatic.

HELICINIDÆ.

HELICINA.

Helicina orbiculata Say, found by the thousands on the calcareous prairies of Bienville, Winn and Catahoula Parishes, and very abundantly in the river drift at Shreveport. This species has a well-established reputation for its variability, and in Louisiana its reputation is well-sustained.

FRESH-WATER SHELLS.

AURICULIDÆ.

CARYCHIUM.

Carychium exiguum Say, found in the damp leaves on the borders of many streams. This form could more appropriately be considered a land shell.

LIMNÆIDÆ.

LIMNÆA.

Limnæa columella Say, abundant in the ponds near Burk Place, La.

Limnæa humilis Say, Bayou Pierre, and Boyce, La.

PLANORBIS.

Planorbis trivolvis Say, var. *lentus* Say, abundant throughout the section.

Planorbis dilatatus Gould, found in nearly all of the smaller streams.

Planorbis bicarinatus Say, in the ponds around Burk Place.

ANCYLUS.

Ancylus obscurus Haldeman, found in nearly all of the smaller streams throughout the section.

PHYSIDÆ.

PHYSA.

Physa heterostropha Say, found in all of the streams and ponds throughout the section.

PALUDINIDÆ.

CAMPELOMA.

Campeloma decisa Say, is as general in occurrence as *Physa heterostropha.* The form called *C. coarctata* by Anthony is found abundantly in many localities. This species is extremely variable, but the forms intergrade too well to separate them into several species.

VIVIPARA.

Vivipara subpurpurea Say, found abundantly in nearly all of the larger streams and lakes. The specimens show great variation, but are too well known to conchologists to need special notice.

Vivipara intertexta Say, Flagon Bayou, Rapides Parish, Lake Satt, pond near Jonesville, Texas. I have specimens from three other localities in Louisiana, showing that the species is widely distributed in the State, but I have never obtained it in large numbers, so it would be considered scarce.

HYDROBIIDÆ.

AMNICOLA.

Amnicolo cincinnatiensis Anthony, Bayous in Claiborne Parish, and Lake Bisteneau. It is extremely abundant in Lake Bisteneau.

Amnicola sayana Anthony, Cross Lake at Shreveport. Not very abundant.

UNIONIDÆ.

UNIO.

Unio anodontoides Lea, is extremely abundant in many of the bayous and lakes. It was collected in Cross Lake, Caddo Lake, Red River at Shreveport, Lake Bisteneau, Corney Bayou, Bayou Pierre, etc. It was found most abundantly in Lake Bisteneau, the species from Red River at Shreveport were the most perfect. Although this species exhibits some variation in size and relative thickness of the shell, the variation is rather slight when compared to the great amount of some other species.

Unio gracilis Barnes, is not very abundant. In Caddo Lake a fine lot of young specimens were collected. It was also found in Cross Lake, Red River (at Shreveport), Dorcheat Bayou, Corney Bayou, Bayou Pierre, and Lake Bisteneau.

Unio purpuratus Lam. This handsome *Unio* is rather abundant. It was collected in Cypress Bayou (Texas), Caddo Lake, Cross Lake, Corney Bayou, Dorcheat Bayou, Bayou Pierre and Lake Bisteneau. The most perfect specimens were in Caddo Lake; here a considerable number of perfect young were obtained. The largest specimen was a dead valve from Dorcheat Bayou, it being about six inches in length. A large number of specimens were collected from little pockets that had been formed alongside Corney Bayou. The characters of this species are very constant.

Unio lævissimus Lea, Caddo Lake, Red River at Shreveport. Rather rare. Some beautiful young were obtained in Caddo Lake.

Unio nigerrinus Lea. Localities: Corney Bayou, Cypress Bayou, La., Dorcheat Bayou and creek near Rosefield. This species is rather abundant. The largest specimens were obtained from Dorcheat Bayou, where the shells, besides being larger than those of the neighboring streams, have thick, somewhat massive, shells.

Unio haleianus Lea. A single specimen was collected by Mr. O. B. Lewis, at Burk Place, in a small creek. I collected a specimen in Castor Bayou, Catahoula Parish, that I take to be of the same species.

Unio mississippiensis Conrad, is abundant in the ponds and creeks throughout the section. It was found in Dorcheat Bayou and in Bayou Pierre, but is usually not abundant in the larger streams. The species does not present very much variation.

Unio hydianus Lea, is found in all of the larger bayous in which I collected—Dorcheat, Corney, etc. The specimens are very numerous. The variation is great, from individuals that are sub-compressed, to those that are very much inflated. There is a marked tendency to become much inflated in old age forms. The number and size of the rays vary much, some specimens have wide rays, others narrow rays, and still others are scarcely rayed at all. This species, on account of its enormous amount of variation, is one of our most attractive and instructive forms.

Unio approximus Lea. A specimen of this species was found in a small creek in Rapides Parish. We think that we are not alone when we consider the difference between *hydianus* and *approximus* almost nominal.

Unio obtusus Lea, was collected by Mr. O. B. Lewis in a branch near Burk Place, in Bienville Parish. Mr. C. T. Simpson so determines a specimen that I sent him, and from Lea's figures and descriptions I would so consider it.

Unio parvus Barnes, is found in a good many of the bayous. It is almost impossible, if not entirely so, to separate this and the three following species, but a good many of my specimens seem undoubtedly *parvus*.

Unio texasensis Lea, abundant everywhere that I collected *Unionidæ*, except in Red River, Cross Lake, and a few very small creeks. These specimens can be gathered by thousands. The variation is enormous, from elongated to rather short; from thin to rather thick shelled, etc.

Unio bairdianus Lea, is considered a synonym of the above. It is abundant in the creeks of the section.

Unio bealei Lea, were collected in the creeks around Mt. Lebanon. This form is extremely close to *texasensis*.

Unio camptodon Say, is found abundantly in the smaller streams throughout northwestern Louisiana. It seems to thrive best in small creeks and brooks that flow moderately rapidly, and have sandy bottoms. This species is so very abundant that, possibly excepting *Unio texasensis*, we are inclined to call it the most abundant species. Its range of variation is extremely great, and from the large suites that we obtained of it and the three following species, it seemed to us that we could trace their intergradation.

Unio declivis Say. Corney and Cypress Bayous in Claiborne Parish, near Mt. Lebanon, and near Jonesville, Texas. Mr. Williamson sent me a specimen with pink nacre.

Unio symmetricus Lea, in the creeks and bayous near Grand Cane. I have a good many specimens through the courtesy of Mr. Geo. Williamson, of Grand Cane. This species and *jamesianus* are, without doubt, synonyms, though a typical *symmetricus* can be distinguished from a typical *jamesianus*. I have seen Lea's types at the U. S. National Museum, and believe these to be pretty typical.

Unio jamesianus Lea, is abundant in the brooks and small creeks around Jonesville, and Port Caddo in Texas. Its habits closely resemble those of *camptodon*, with which its seems to connect by intermediate forms.

Unio lachrymosus Lea, is one of the most abundant of the species found in the section. Specimens were collected in Lake Bisteneau, Caddo and Cross Lakes, and in Bayous Dorcheat and Corney. The specimens are found in large numbers. The amount of variation is considerable, some specimens having a great number of pustules, while others have relatively few. Some specimens are much more compressed than others. The largest and heaviest specimens were from Caddo Lake.

Unio asper Lea, Corney Bayou, is found in other localities most likely; shows some variation in the number of pustules.

Unio pustulosus Lea, is not very abundant. Is found in most of the lakes and principal bayous. It is most abundant in Dorcheat Bayou. The specimens from this place are somewhat more inflated than most of the specimens that I have seen from the more northern States. Some of the variations of *pustulosus* approach very near to *turgidus*, and I am inclined to the opinion that these two forms connect by intermediate examples.

Unio schoolcraftii Lea. Corney Bayou. Not very abundant.

Unio nodiferus Conrad. Corney Bayou. Not very abundant. These specimens seem almost fac-similes of those in the Philadelphia Academy of Natural Sciences collection from Neches River, Texas.

Unio turgidus Lea. Dorcheat Bayou. Somewhat abundant in this stream.

Unio pustulatus Lea. Caddo and Cross Lakes, Lake Bisteneau. It is abundant in the two first lakes. It varies very much in the amount of the development of the pustules.

Unio houstonensis Lea, is found in the three larger lakes and Bayou Pierre.

Unio trigonus Lea. Cross Lake, Bayou Pierre and Dorcheat Bayou. This species and the next two form a most interesting and a somewhat perplexing set of forms.

Unio cerinus Conrad, is found abundantly in nearly all of the bayous and the larger creeks throughout northwestern Louisiana. Many hundreds of specimens were obtained from Corney Bayou. It varies enormously, and undoubtedly grades into the next species.

Unio chunii Lea. Corney Bayou, Dorcheat Bayou, Cross Lake. It is somewhat abundant in Corney Bayou. It varies greatly, sometimes being arcuate on the base, almost hooked as the posterior margin is approached. The sharpness of the posterior ridge from the umbo varies much, as does the amount of inflation of the valves, forming, it seems to me, perfect gradations into *cerinus*.

Unio cuneus Conrad. Corney Bayou. Rare.

Unio cornutus Barnes. Caddo Lake, Cross Lake, Bayou Pierre. Not very abundant, and very constant in its characters.

Unio castaneus Lea. Corney Bayou, Cypress Bayou, Dorcheat Bayou. It is very abundant in these streams. The specimens from the two first are very small and somewhat compressed; those from Dorcheat are the largest that I have ever seen. These latter specimens are much thickened anteriorly are much inflated in that portion, but are compressed posteriorly. The male individuals are rather pointed behind, and the females are truncated.

Unio elegans Lea. Caddo Lake, Cross Lake, Corney Bayou, and Bayou Pierre. Very scarce.

Unio donaciformis Lea, in the larger Lakes and Bayou Pierre. Very scarce.

Unio plicatus Lea. Bayou Pierre. Mr. Williamson sent me the only specimens that seem to me undoubtedly this species.

Unio perplicatus Con. Ouachita River, Bayou Pierre.

Unio multiplicatus Lea. Caddo Lake, Cross Lake, Dorcheat Bayou, Bayou Pierre. The finest specimens were from Cross Lake, near Shreveport. These would rival some of the monsters from Spoon River, Ill., and seem entitled to the name *heros.*

Unio undulatus Barnes, Bayou Pierre. Mr. Williamson has sent me some specimens that seem best placed under this species, though they could, without especial violence, be called *multiplicatus.*

Unio boykinianus ? Lea. Dorcheat Bayou. I collected one specimen that has been so identified by Mr. A. A. Hinckley. I have seen specimens of the species in the Philadelphia Academy, and have looked up Lea's figure, and think that my friend is about as nearly right as can be in some of these delicate matters.

Unio trapezoides Lea, abundant in the larger lakes and bayous. I have also received specimens from the Ouachita River in Union Parish. In Caddo Lake this species is the most abundant. I collected many hundreds there. Some of the largest specimens, however, were from Cross Lake. This species seems to like the larger bodies of water where it has a considerable extent of rather level bottom of somewhat soft mud to dwell in. The characters of this species are, in the main, rather constant. The amount of inflation varies a good deal, as also does the postero-basal angle in sharpness; and the posterior ridge from dorsal to basal margins varies in its acuteness. There is a considerable variation in the distinctness of the folds, but the trapezoidal outline, the black epidermis, the purple nacre remain constant, the variations being of essentially one type of structure.

Unio tuberculatus Lea. Corney Bayou, Dorcheat Bayou, Bayou Pierre, Cross Lake. It is rather abundant in the two first localities. Some of the specimens from Corney Bayou had the posterior portion very much elongated. Both the purple-nacred and white-nacred varieties were found.

Unio gibbosus Barnes. Corney Bayou. A small, compressed variety was found in great abundance in this stream.

Unio rotundatus Lamarck. Cross Lake, Bayou Pierre. This species is rather rare in Cross Lake, but, judging from the number sent me by Mr. Williamson from Bayou Pierre, it must be very abundant there. It is found abundantly in southern Louisiana. It appears that when northern Louisiana is reached, the northern extension of the species is being approached. A specimen of this species was collected on the border of Cross Lake, September 26, 1891, supposed to be dead. It was laid upon my table to await a convenient opportunity for washing and putting away. On November 18, I tried to prize the valves open, but they would not yield. The animal was cut out, and its heart was seen to be still beating. The mussel had lived almost two months on my table, out of the water.

MARGARITANA.

Margaritana confragosa Say. Caddo Lake, Lake Bisteneau, Cross Lake, Corney Bayou, Bayou Pierre. The species is rare everywhere, but is most abundant in Caddo Lake, where I collected about one dozen specimens.

Margaritana complanata Barnes. Corney Bayou. Rare. Out of a great many thousand specimens of *Unionidæ* from Corney, I obtained only two of this species.

ANODONTA.

Anodonta tetragona Lea. Dorcheat and Corney Bayous. Not abundant.

Anodonta stewartiana Lea. Lake Bisteneau and in a pond near Jonesville, Texas. Rare.

Anodonta gigantia Lea. Pond near Shreveport, and in a pond in Claiborne Parish. Near Shreveport, in a sequestered pond, into whose surface the sunbeams filtered through the willows, I made a rich "find" of a bushel of these *Anodontas.* They were the most beautiful specimens of the genus that I have seen, many being a most beautiful but subdued green—all as thin as egg-shells.

Anodonta corpulenta Cooper. Caddo Lake, pond near Shreveport, Bayou Pierre. Not abundant. This *Anodonta*, with the two mentioned just above, have a wonderfully close resemblance, and I would not like to undertake to never get them mixed up. I am inclined to believe that they are *naturally* mixed up, and that it is *artificial* to try to draw sharp lines between them.

Anodonta opaca Lea. Cypress Bayou, Black Lake Bayou, Corney Bayou, ponds around Jonesville, Texas; around Grand Cane; and I have received some good specimens from southern Arkansas. The finest specimens were from Jonesville, some being about six inches long, and with an epidermis of a beautiful polished mahogany color. This is by far the most common of the *Anodontas* in the section. At one time I had two hundred and fifty specimens from *one* bayou. The variation is enormous. The color is from mahogany to green, the form may vary from an elongated oval to a short oval, or the base may be arcuate, the size may vary in what appears to be adult specimens from two to five inches. Yet in spite of all this variation with a good suite of specimens, one readily sees that it is all the same species, for every intermediate form exists.

Anodonta suborbiculata Say. Caddo Lake. Very rare. This is such a handsome species that one wishes it could be found wherever he collects, but he is disappointed in Louisiana. In Caddo Lake a few small specimens are found.

CYRENIDÆ.

PISIDIUM.

Pisidium variable Prime, found in many of the small branches. Near Port Caddo, Texas, not far from Cypress Bayou, small peat mosses have formed between the bases of some of the hills. These mosses are fed by springs. In small holes over this moss hundreds of this *Pisidium* can be collected by pulling up the moss and other aquatic or semi-aquatic plants and examining their roots.

SPHÆRIUM.

Sphærium contractum Prime, in the ponds and creeks around Jonesville, Texas, and in Cross Lake, near Shreveport.

Sphærium fabale Prime, in nearly all of the smaller streams of northwest Louisiana, and is often found in the greatest abundance. It is the most common species of the genus in the section.

Sphærium transversum Say. Dorcheat Bayou and Lake Bisteneau.

There are, undoubtedly, many other species of the *Cyrenidæ* in the section. We have collected immature examples of other species, but there is too much doubt attached to their identification to justify entering them on this list.

Cambridge, Mass., July 16, 1893.

TRENTON AND SOMME GRAVEL SPECIMENS COMPARED WITH ANCIENT QUARRY REFUSE IN AMERICA AND EUROPE.

BY H. C. MERCER.

The recent Trenton gravel discussion impresses upon us, two important points:

(a) The proved fact that in the fashioning of his larger stone blades, the modern North American Indian continually scattered his quarry sites, with forms like the Trenton forms.[1]

(b) The assertion that the Trenton specimens (see collection at Peabody Museum, Cambridge, Mass., Figs. 4 and 5,) may not have been found in place, but in talus, or where they had "slipped down," and that if in place, they did not prove a paleolithic culture, since if, as is possible, they were "rejects or wasters" dropped at quickly abandoned "workshops" on the uninhabitable river shore, the camp-site of the man who made them, with his "finished implements" and culture-telling traces, would probably have existed elsewhere higher up the bank.

In the demand for renewal of evidence which has grown out of the argument, we not only ask whether the Trenton objects are really found in place, whether they are "finished implements," and whether the old river shores are analogous to modern quarries where the gravel man would leave no more definite trace of himself than a "waster;" but, turning to Europe, whence the discussion has drawn its first inspiration, we wonder what effect the study of American Indian quarries is to have upon the question there. We inquire not unnaturally—

---

[1] For a study of the "unfinished implements" made by modern Indians, at Flint Ridge, Licking Co., Ohio, see a paper by Gerard Fowke in the Smithsonian Report for 1884, and papers by W. H. Holmes upon the aboriginal quarries at Piney Branch, D. C.; and in Garland County, Arkansas, in American Anthropologist for Jan. 1890 and Oct. 1891. The Unpublished Report for 1892 of the Department of Archaeology of the University of Pennsylvania contains a discussion of similar facts discovered in the summers of 1891 and 1892 at Durham, Saucon Creek, Vera Cruz, and Macungie, in Eastern Pennsylvania.

Are the *European* objects really found in place?

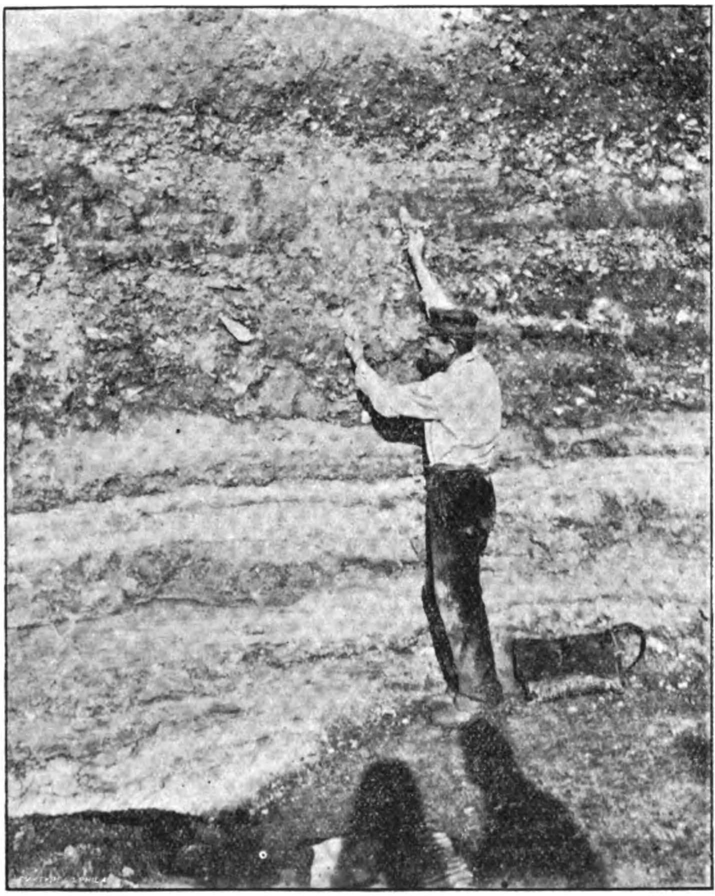


FIG. 1.

Chemin de Poste quarry, Abbeville (upper and oldest terrace), showing the unstratified "Limon rouge" resting upon stratified layers. Workman holds "axes" about where he says he found them in the "Limon rouge," December, 1892.

Do the Trenton specimens really resemble them?

Are the European specimens finished implements?

Have European archeologists overlooked the fact that there are later Stone Age quarries abroad, which, like the American sites, tell the story of blocked out "wasters" resembling gravel forms?

Postponing a few words of suggestion as to the first three questions, I venture here, on the strength of several recent visits to the Somme Valley, to discuss the last four, and first the question of

POSITION IN UNDISTURBED GRAVEL.

It is well-known that the Somme having cut its valley through the secondary chalk of northern France, had, in Quaternary times, washed up beds of gravel at bends, notably at Abbeville and Longpré, and at St. Acheul and Montieres (suburbs of Amiens). It was in these that Boucher de Perthes, after a long battle, was allowed, in 1859, to have really found his "haches" or "coups de poing" in place.

Visiting Abbeville in November last, and securing the kind assistance of M. G. d'Ault du Mesnil, a well-known geologist and paleontologist and member of the Ecole d'Anthropologie, who, as an inhabitant of Abbeville, had devoted much study to the gravels, I examined all the exposures near the town, then those of St. Acheul and Montieres, and finally the cuts at Chelles where the Marne has done the same work.

The sand and gravel pits (see Fig. 2, infra) A, Leon; B, Chemin de Poste; and on the open land, "Champ de Mars"

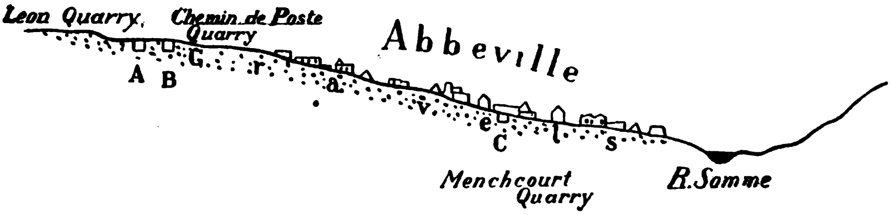


FIG. 2.

Diagram showing the general relative position of the Quaternary gravels to the River Somme at Abbeville (Dept. Somme) France, and A the Leon, B the Chemin de Poste, and C the Menchcourt sand and ballast quarries, from which chipped specimens and fossil bones have been obtained.

behind the town, are about a mile from the tide-less fresh-water Somme, and about 40 meters above it. They are holes dug in gardens and grass fields, on an exceedingly gentle slope, and their position avoids the difficulty of comparatively modern talus encountered at the celebrated Trenton bluff, just as a well or cellar dug in the middle of the latter city would.[2] C is the Menchecourt quarry near the river. A and B might stand as well for the St. Acheul pits if Abbeville were Amiens, when C would do for Montieres.

The gravel pits A and B, at Abbeville, will serve as types. The cuts, now about 10 to 18 feet deep, were, at places, clean and fresh, and showed veins of sand in white, yellow and red, and layers of large flint nodules, round by nature and packed in gravel, the whole overspread by the "Limon rouge," an unstratified layer 3 to 6 feet thick, of sand, gravel and weather-broken flint splinters.[3] Classed as the last phenomenon of quaternary times, this "Limon rouge," tinted brownish red by atmospheric agencies, had, said geologists, rolled like a pudding over all the gravel area, from the uppermost or oldest terrace or bed, to the lowest or latest.

The difference between these exposures and those at Trenton was striking. There, where all stones were water-worn pebbles, and but few constituted blade-material for primitive man (argillite), here, scarcely any were water-worn, and nearly all were blade material (flint). In Trenton there was no fossil-preserving chalk; but here the presence and chemical effects of chalk were everywhere apparent.

[2] There is a "Puit" at the Leon Quarry, where at hole formed by decomposition in the underlying chalk, an area of about 75 feet square has settled down 4 or 5 feet. The stratification of the sunken area is somewhat jarred, but its line of faulting clearly marked against the clean cut layers to the right and left. The danger of replacement as well as those of changed water-courses anciently filled up, root holes, uprooted trees, confront the student here as everywhere. Well might he use caution, even were he in a hole 100 yards from the bluff's edge at Piney Branch, at the bottom of a trench 200 feet from the "quartz workshop talus" at Little Falls, or down in the Trenton sewer.

[3] This phenomenon of weather splintering can easily be seen still at work. Many nodules yet unbroken, show on their surface discolored lines fringed with dendrites, marking planes of internal decay which have so weakened the mass that it falls at once into angular pieces on being struck a good blow.

My first object after observing my height above the river and the colored lines of stratification, with their inference of a valley-filling flood, was to note all evidence in proof of the quaternary age of the gravels, and of the occurrence in them of the chipped specimens and fossil bones that had made the spot famous.

I carefully examined every cut at the Leon, Chemin de Poste, and Menchecourt quarries, and afterward searched those at St. Acheul and Chelles, and the Archeological Museum of the University of Pennsylvania now contains three apparently artificial chips, which I then found in place; (1) Museum number 11456 with 3 facets on one side, showing the bulb of percussion, and well worn or worked on the edges, found and photographed in place 1½ meters below the surface at the Chemin de Poste quarry; (2) Museum No. 11454 apparently artificial with 6 facets on one side, in place 2½ meters below the surface at the Chemin de Poste quarry, and (3) Museum No. 11456, a thin flake showing the bulb and concentric circles of percussion, at the Leon quarry 2 meters below the surface. But the flint nodules of Abbeville flake very easily when struck against each other, and when we realize that the gravel deposits have been "ravined" by streams in past time, that cavities have been formed in the chalk, into which the flints have fallen with more or less suddenness and force, and that the original deposition of the strata must have been accompanied with some jostling of nodules, we need not attribute every flake showing the bulb of percussion, to the hand of man.

These specimens though far more artificial looking than many that have been proved artificial by surrounding circumstances must therefore be classed as doubtful, and we will not perplex ourselves with an analysis of their position in its exact relation to unstratified Limon Rouge and the stratified beds beneath.

Beyond these possible traces of human handiwork, I found nowhere a fossil or "coup de poing" in place.

However, at the Leon quarry, a workman showed M. du Mesnil myself 3 typical leaf-shaped specimens, recently found, he said, by him, one of which was covered with white patina, and three months later (on a second visit), sold me an elephant's tooth at the quarry (for 2 francs). Another laborer at the Chemin de Poste quarry sold me (for 4 francs) four chipped specimens (2 patinated), and again, three months later, 8 (for 5 francs) found by him, he said, in the " Limon rouge " at the spots indicated (see photograph, figure 1). At the Boulevard quarry at St. Acheul, I bought of a third workman, at least a dozen broken "axes" and chips, some of them well patinated, together with the bones of a *Bos primiginius* (for 5 francs).[4] A fourth quarryman, at Chelles, where two tables in the foreman's shed were piled with "axes" and the teeth and bones of the *Rhinoceros tichorinus, Elephas primiginius, Equus caballus* and Reindeer recently found, it was said, and reserved as the property of the company; sold me at his house a number of patinated chips and "coups de poing," together with three teeth of the *Equus caballus* (for 5 francs).

Nothing so distinguishes the Delaware from the Somme Valleys; nothing so eliminates, from the study of the latter, the doubts as to readjustments and talus, the possibilities as to river levels and distant glaciers, which perplex the American investigator, as the presence of these fossils, thus luckily preserved by the chalk, and in sufficient numbers, it seems, to convince all men of science who have visited the spot. Though I found none with my own hands, it would have been hard to believe that those I saw at the quarries, in the Du Mesnil collection, at St. Germain, and in the Boucher de Perthes Museum, at Abbeville, had come from the surface or from anywhere else than the gravels themselves.[5]

---

[4] One of the flint "axes" he laid aside, saying that it was an imitation.

[5] Beyond these, thus labelling the beds in general as quaternary, the closer study of the bones had enabled paleontologists, I was told, to make out an evolution in the fauna of the valley, and distinguish three divisions or terraces—an upper, the oldest, marked by the prevalence of the *E. antiquus, Rhin. merkii,* and the advent of man; the middle marking the decadence and extinction of the *Elephas antiquus* and the *Rhin. merkii,* the prevalence of the *Rhin. tichorinus,* and the appearance and great increase of the Mammoth; and a lower, the latest, represented by the extinction of the Mammoth and the prevalence of the Reindeer.

The Carriere de Leon, Port St. Gilles, and Chemin de Poste quarries now represent the upper; the Balastiere du Chemin de Fer the middle, and the Menchecourt quarries the lower terraces.

The cut at Moulin Quignon and most of the exposures worked by Boucher de Perthes are at present covered.

As to the artificially chipped flints (see Fig. 3), twelve of those obtained by me were patinated with the brown, yellow, red and white patina that no art can adequately reproduce, for the forged patina is a crust, the real a decomposition into the stone.[6] To prove that they, like the fossils, came from the gravels, no evidence was wanting save that of a personal discovery.

COMPARISON WITH TRENTON SPECIMENS.

Did the Trenton forms resemble these French objects? was the next question. Figure 3 (omitting the so-called Mousterian flakes specialized on one side, and the thin, knife-like flakes and hammer stones from the upper beds) gives the three

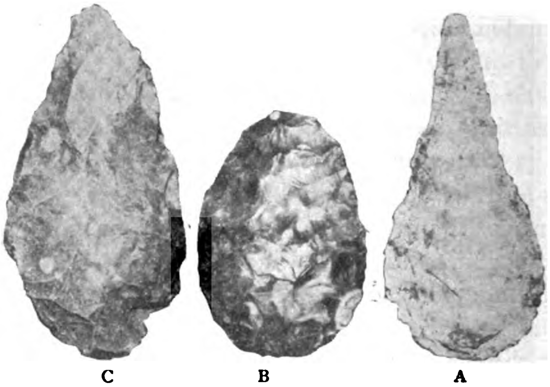


FIG. 3. ¼

Typical specimens of flint from the Somme gravels at Abbeville. D'Ault du Mesnil collection. (Photographed by the kind permission of M. G. d'Ault du Mesnil.)

A. Specialized only at the point. Rude at the base.
B. Specialized all round. Leaf-shaped.
C. Unspecialized. Resembling usual Trenton forms.

---

[6] Some "forging" of specimens has been carried on in the Somme Valley, as the drawers full of imitations at St. Germain, and the specimens shown me in the Du Mesnil collection prove. M. du Mesnil has even detected skillful attempts at imitation of white patina at Amiens. He informed me that my unpatinated specimens were genuine. But they can be eliminated from the evidence without depriving it of much force.

important shapes found in the Abbeville pits. Figs. 4 and 5 present fifteen representative specimens from Trenton, in the Abbott collection at the Peabody Museum, Cambridge, Mass.

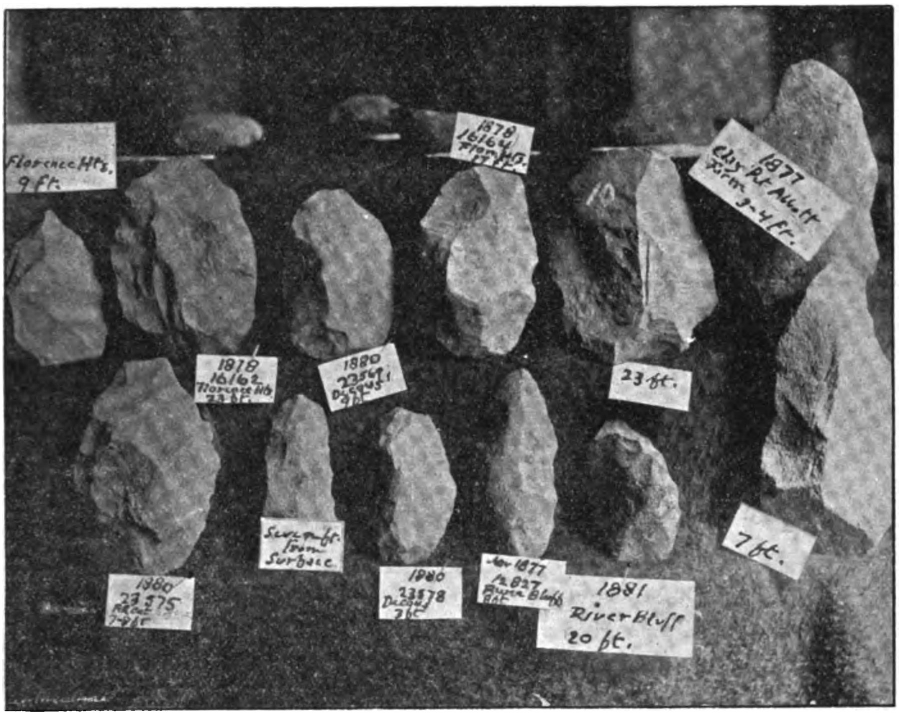


FIG. 4. ½

Trenton specimens of argillite from the Abbott collection, Peabody Museum, Cambridge, Massachusetts (photographed by kind permission of Professor Putnam, and Dr. C. C. Abbott, in September, 1893). Tickets show catalogued number of specimens, date of discovery, site, depth in Trenton gravels, etc., as stated in the Museum records.

The Trenton forms generally resemble C, Fig. 3. None are so finely worked as B (the duplicate of our heavier cache specimens[7]), while A, the most striking of all the "coups de poing," scarcely worked at the large end where the nodule surface often remains, and finely specialized into a narrow point at the other, is, with the exception of the three specimens in Fig. 5, (the only ones of the kind from Trenton with a record as to depth and position), unlike anything in the described Trenton series, nor is it fairly duplicated by any of the American quarry or workshop discoveries that I have seen.

---

[7] As, for instance, the 8185 flint blades arranged in sets of about 15, in mound 5 of the Hopewell group on the north Fork of Paint Creek, Ross Co., Ohio, discovered in 1847 by Squier and Davis and fully exhumed in 1891 by Mr. W. K. Moorehead (Primitive Man in Ohio, p. 189) or the 6107 similar blades, similarly placed, found by Dr. J. F. Snyder in 1890 in a mound on the right (Illinois) river bank near Beardstown, Brown County, Illinois. (See The Archeologist for Oct., 1893.)

In the Boucher de Perthes Museum there are (down stairs) 48 specimens of A, (Fig. 3) and 47 of B. In the British Museum, 192 British specimens of A (Fig. 3) and 30 of B. Of C there are 32 in the Boucher de Perthes, and 97 (from Britain) in the British Museum, and the fact that these latter, save in material, are exactly resembled by the Trenton forms and American quarry specimens, brings us to the next question.

IMPLEMENTS FINISHED AND UNFINISHED.

Are the European specimens finished implements? In attempting to answer which the following facts offer some suggestion.

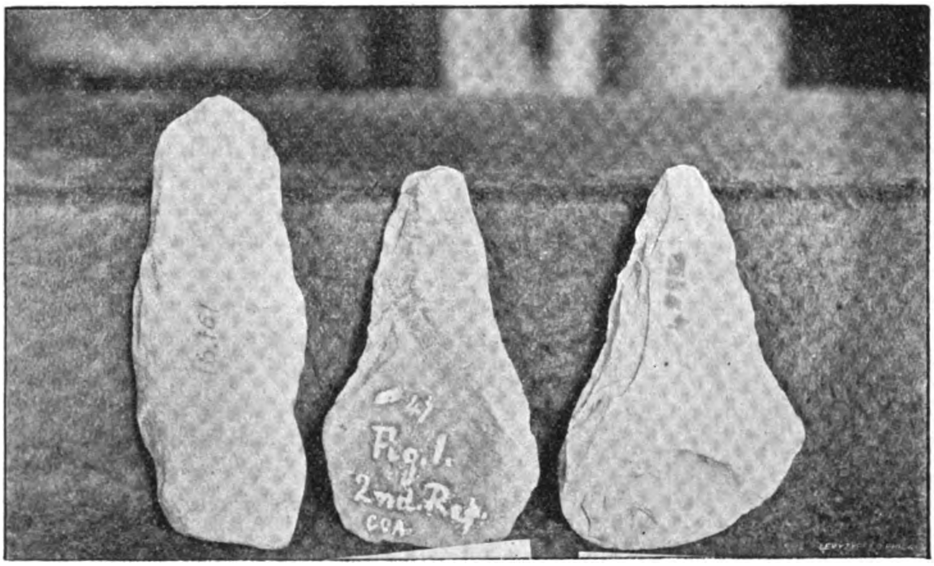
Of the 48 French (Boucher de Perthes, Abbeville) examples of A (Fig. 3), all very rude and unworked at base, where 28 retain the pebble surface, 29 are quite unmistakably specialized at the point; and of these 29, 10 look freshand unused, while 19 seem to show signs of use or water wear. Of the 152 British (Museum) A's, 96 are unmistakably specialized at the point, while very rude, and generally showing nodule surface at the base.

Eleven of the 47 French B's (well-specialized all around, 3 to 5 inches long), show signs of use or rolling.

Of the 32 French C's about 14 look rolled or used, and of the 97 British C's (of which W. G. Smith's unused-looking specimen resting on the elephant bone, in the "Paleolithic floor" case, is one), about 20 are made, not of flint, but of red quartzite.

Water, rather than use, may have rolled and nicked the edges of any of these flints (except, perhaps, W. G. Smith's) since they were made, and if we must eliminate these battered cutting edges (which I did not look for in the British cases) from the pros and cons of a gravel specimen, whether in Europe or America, nothing remains for the student but analogy with stone implements from other regions.

Judged by this, the 77 French and British B's might have to be left out, because they resembled American cache forms. But the 19 French and the 152 British A's, rude masses tapering to fine points, could not, until some ground of doubt is suggested, escape the category of finished implements.



No. 16161.
4 feet from surface,
R. R. cut, 1878.

No. 11752.
Gravel of Trenton
bluff, 7 feet.

No. 45913.
R. R. cut, 7 feet.
May, 1888.

FIG. 5. ½

Three Trenton specimens (Abbott collection, Peabody Museum, Cambridge, Mass.), rude at base and worked to points, resembling (though lacking the specialization of the latter) the rough based pointed forms from Europe (see FIG. 3, A). The labels on the margin give the Museum record.

As to the position of these forms in the Somme gravels, M. du Mesnil makes a statement which, though contradicted by

---

[8] Five of the 47 French are little ones, from 2½ to 3 in. long, also well-specialized. The 30 British specimens of B are much ruder than the French. There are also 5 or 6 little French specimens, 2 to 2½ in. long, of the rude pattern C. Eighteen French or 56 British look like blocked out or unfinished forms of A.

certain archeologists is of the greatest interest to the American student—that while A and C begin at the oldest layers and continue through the newest, B only begins in the middle stratum (with the Mammoth), to continue thenceforth with the others to the top.[9]

Granted the correctness of this observation, the student of American quarries would be tempted to call C, when lying as it does in the later beds, at or near the more perfect forms, a "waster or reject," a preliminary step in their manufacture.

When found alone, however, in lower strata of the same gravel, he must fairly ask whether it does not represent an earlier stage in the process of stone chipping, when the savage, unskilled to proceed farther in the then experimental art, would have halted and treated as a finished tool, the same form which later, where finer work was understood and required, he would have cast aside as a "reject."

This brings us to the last question :

THE "WASTER" OF THE EUROPEAN ("NEOLITHIC") QUARRY.

Are there .late Stone Age quarries abroad, which, like the American sites, tell a story of bocked out "wasters" resembling gravel forms?

At Grimes Graves (near Brandon, Suffolk, England) Canon Greenwell found, in 1880, surface conditions resembling those at Macungie, Lehigh Co., Pennsylvania).[10] After digging 40 feet down into an ancient pit, he discovered horizontal galleries, and in them several chalk cups, a phallic figure cut in chalk, and pick-axes made of stag antlers, on one of which was the muddy imprint of a human hand. Cissbury (near Worthing, Sussex, England) explored by Col. A. Lane Fox, in 1867–75, repeated in general these discoveries.

---

[9] The opponents of this statement say that B has been found in the oldest layer. Its advocates, that when such has seemed the case, the specimens tumbled down through the ravining of streams. Unfortunately, it appears that in the demonstration of these points, few exact records have been kept of the stratigraphic position of specimens discovered. None, as far as I could learn, had been photographed in place, and probably not one in fifty was found by a scientific observer with his own hands. "We need," said M. Reinach, in the St. Germain Museum, "a kind of hermit to live in the quarries, and pounce upon specimens as workmen find them."

[10] See Notes on Exploration of Aboriginal Jasper quarries in the Lehigh Hills in 1891–92 (Popular Science Monthly, September, 1893.)

At Grand Pressigny (near Tours, France), the fields are scattered with nuclei and thin flakes of flint worked from neighboring rock in situ, and no doubt there are hundreds of other European quarries yet unexplored, illustrating the handicraft of peoples living in times geologically more recent than the drift.[11]

But Spiennes (near Mons in Belgium) will suit our purpose. Here M. M. Cornet and Briart saw, in 1868, a railway cut expose pits and horizontal burrows as at Grimes Graves and Cissbury, in one of which, at a depth of 8 or 10 feet, a fire-site and potsherds were found. The surface and slope of the chalk hill along the little valley of the Trouille, though talus hides the pit profiles, and the surface depressions are level, is still littered thick with refuse, which is, if we may believe European archeology, the work of a man who could make pottery and polish stone tools, and who, as compared with the Drift savage of the Somme is, geologically speaking, a modern individual.

I visited Spiennes in March, 1893, and, after seeing a neighboring collection, and carefully examining the refuse-covered area and several piles of " pierres taillès " in adjoining gardens, gathered with my own hands and obtained from peasants on the spot, a fairly illustrative series of the chipped forms of the quarry.

Figure 6, omitting nuclei and unworked chips, represents the types of the collection (142 specimens in all, including 4 hammer-stones).

Again, as in the American quarries, the story of partly finished implements preceded by " wasters " and inchoate forms, is plainly told. The considerably specialized results of the stone chipper's work at Spiennes, are shown in the two groups, A and B.

---

[11] I. e., according to the European classification, the men of (a) the cave period, (b) the neolithic period, (c) the bronze period.

The paleolithic cave men, who, as we are told, never polished stone, polished bone, and scratched outlines of animals on bone, superior in realistic skill to anything done in the Bronze and Neolithic Ages. At Solutre, they chipped long, thin blades, equal to fine Mexican and Californian specimens, and at the quarries and workshops where these were fashioned, the American student might expect to find a set of " wasters " very familiar in appearance, yet certainly "paleolithic."

Of A—a long, narrow blade, worked to a point—I have 7 broken examples, and of B—the chipped celt—worked to a round cutting edge, 8 specimens likewise broken. Both A and B are plainly ushered in by a series of rude, less-specialized shapes, group a (of which there are 36) tending toward A, and group b (of which I have 35) tending toward B.[12]

When we come to group C, representing a series of inchoate masses, 19 in number, too little worked to be classified with the rugged relatives of either A or B, we realize a self-evident fact often before forced upon our attention. Having descended too far in the scale of chipped forms, we have lost our bearings. Judgment by type is at an end. Inference is dangerous. We have reached the point where the fortunately-discovered hearth, the blackened potsherd, or half-eaten bone must help to tell the tale—the point where all stones flaked but of a few chips, like "all cats in the dark," are alike.

And the fact that this group C, from Spiennes, certainly runs into and resembles the rude drift forms from the Somme (Fig. 3, C) the American quarry-refuse specimens above noted, and Trenton Specimens (Fig. 4) means but little, when we observe, as we must, that the most specialized forms from the Spiennes quarry (Fig. 6, A and B) and Drift (Fig. 3, A and B) are quite unlike. Here we infer, if we may infer anything from the shape of worked stones, that where the quarry man was aiming at a thin, elongated blade, or a celt with round cutting edge, the Drift Man was working out a broad, leaf-shaped form, or the unique massive ended "coup de poing."

---

[12] Two broken, polished celts, (group B) were obtained by me from a peasant at Nouvelles, 1½ miles away. But a peasant at Spiennes spoke of finding polished celts near the pits. So does Canon Greenwell, quoting M. M. Cornet and Briart in Journal of London Ethnological Society, 1871, p. 433.

The above numbers are given as they, from my own observation, seem to show roughly the relative proportion among the refuse, between the more finished and rude forms.

SUMMARY.

To sum up the above conclusions. A visitor, though refusing to take anything on authority, could find no fair reason to doubt that the French implements are found in place in the Somme gravels associated with quaternary fossils, as asserted by European writers. The whole question is simplified by the frequency of bones.

The Trenton specimens, though resembling the ruder and less specialized French types, never duplicate the specialized forms. The shape alone of the remarkable "coup de poing" (Fig. 3, A) separates it from all Trenton specimens (except the three in Fig. 5). But its best examples are well-specialized, as is its more familiar leaf-shaped companion (Fig. 3, B), while none of the Trenton specimens are so.

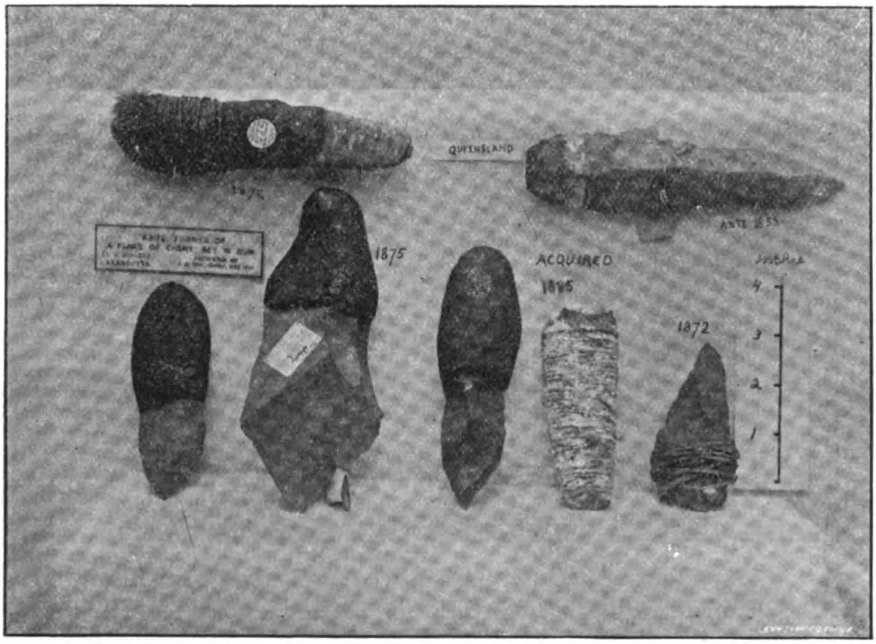


FIG. 7. $\frac{2}{3}$

Australian stone flakes (unspecialized) set in gum handles and used as knives. (Photographed by kind permission of Mr. C. H. Read, British Museum).

Judged by the American quarry standard, certain of the above-mentioned ruder French forms (Fig. 3, C) might be classed as "rejects" thrown aside by the Drift Man in the fashioning of his finer blades (A and B).

The European neolithic quarry of Spiennes, like the American quarries, illustrates the production of "wasters" in the fashioning of large stone implements. But, in its more specialized results, the chipped celt and the long, narrow blade, it offers no resemblance to the leaf-shaped "hache" (Fig. 3, B) and the massive-ended "coup de poing" (Fig. 3, A) of the Somme drift.

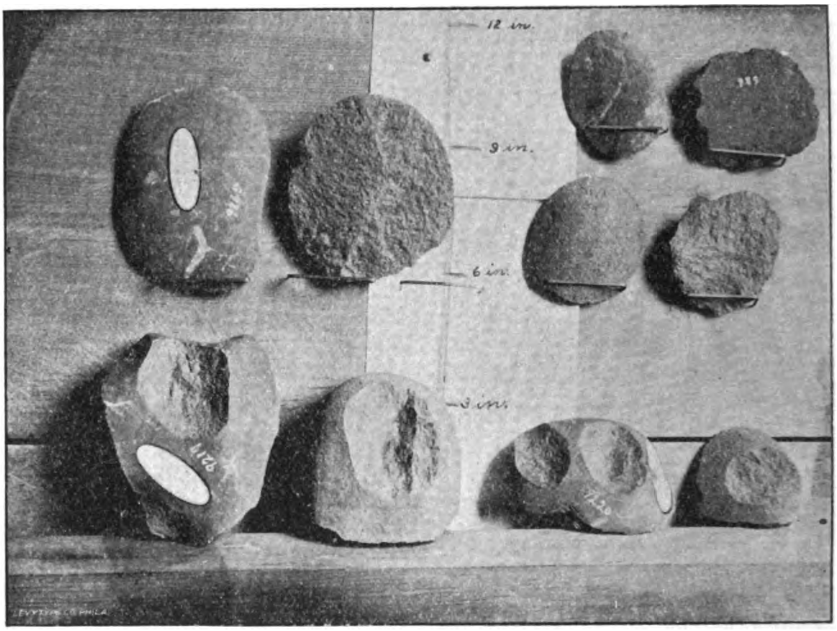


FIG. 8. $\frac{4}{13}$

Stone discs (resembling the "Teshoas" seen by Dr. Leidy in use among the Fort Bridger Shoshones as hide scrapers, in 1870) and river pebbles from which similar discs have been chipped. Found at Indian surface village sites in Delaware and Susquehanna Valleys in 1892.

While making these comparisons, we have realized that the light thrown upon the subject by the study of American quarries, important as it is, by no means settles the manner by which all peoples in an age of stone made their blade-like implements, or gives us a universal clue to a "finished implement" wherever found.

We must bear in mind (1) that the Easter Island hafted obsidian splinters (Fig. 9) and the Australian unworked flakes (Fig. 7) set in masses of "black boy" gum, for use as knives, hammering tools or saws, prove that specialization is not a universal test of a finished implement. Though as "finished" as arrow-heads, who would call them so when the mounts had rotted? And who could distinguish the white flint flakes used recently by the Andamanese to shave their heads,[13] or the Admirality Island knife-chips of obsidian minus the gum, from "quarry refuse."

(2) That the "Teshoas" used as scrapers by the Shoshones (observed near Fort Bridger by Dr. Joseph Leidy in 1870),[14] of which I have found duplicates in the Delaware and Susquehanna Valleys, together with the pebbles from which it appears that they have been knocked (see Fig. 8)[15], are, though finished implements, not specialized, and illustrate a phase of pebble chipping not noted in the study of quarries.

(3) That the above-mentioned Easter Island hafted splinters, (See Fig. 9) though again finished implements, could not have been preceded by "turtlebacks" in their manufacture, and that the Jasper flake exhibited in the National Museum (see Ray Collection and Smithsonian Report, 1886, part 1, plate XX) as the starting point for arrow-head making among the north-west coast Indians, would probably not have looked like a "turtleback" or "quarry reject" if cast aside after partial working.

I found several little "turtlebacks" at the Jasper quarry at Macungie (about one inch in length), while the well-worked end of a small blade protruding from a shapeless mass at the Saucon Creek quarry, seemed to evidence a procedure not involving the production of "quarry rejects" of leaf-shaped form. And it seems hard to escape the conclusion that if in some American cases the finished arrow-head or small blade is the fit survivor of a family of leaf-shaped "rejects;" in others (as certainly in the Mexican flake arrow, worked only on one side), it sprung from the nearest available chip, no more resembling the ovate quarry forms and Trenton specimens than would a bit of ill-worked bottle glass cast aside by California Indians.

---

[13] See Observations by Col. A. Lane Fox, Journal of the Anthropological Inst. of Great Britain, etc., May, 1878, p. 446.

[14] See Hayden's U. S. Geological Report for 1873.

[15] See paper on "Pebbles Chipped by Modern Indians, as an Aid to the Study of the Trenton Gravel Implements," Proc. Am. Ass. for Adv. of Sci., Vol. XLI, 1892, p. 287.

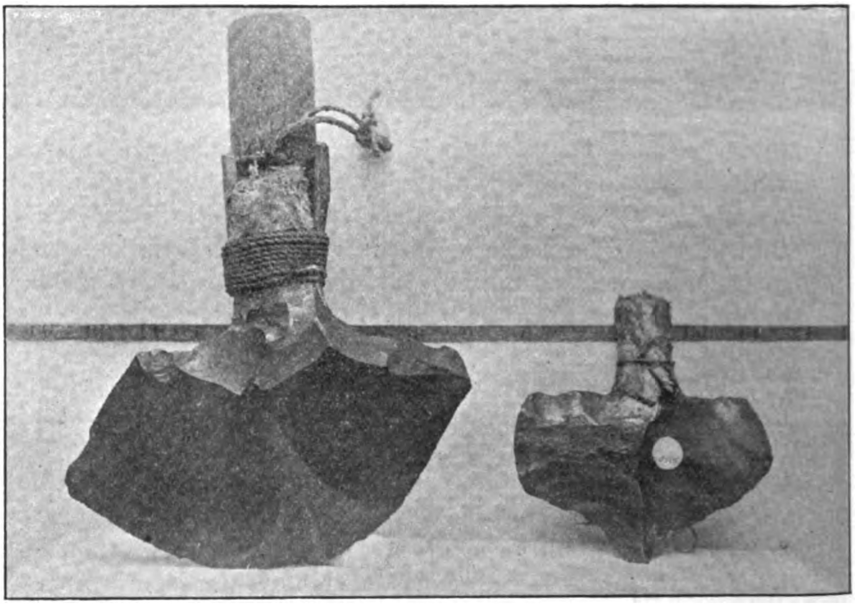


FIG. 9. $\frac{2}{7}$

Rude hafted flakes of obsidian from Easter Island.
(Photographed by the kind permission of Mr. Charles H. Read, British Museum).

EDITORIALS.

—It has always been recognized that scientific research is greatly furthered by the exchange of the various objects with which that research is concerned. For the transmission of objects of Natural History from one country to another, the mails have offered a cheap, speedy and reliable means. Heretofore, through the laxity with which the regulations on the subject have been enforced, it has been possible to enter such objects in the mails of the Universal Postal Union as samples of merchandise and under the rates of postage therefor. From official information lately received from the Post Office Department of the United States it appears that such a rating is entirely unauthorized by existing provisions, and that objects of Natural History may be mailed to countries of the Union only at the rates required for letters. The United States Post Office Department also states that it had recently submitted a proposition to the countries composing the Postal Union, to modify the regulations so that such specimens might be received into the mails at the same rates as samples of merchandise, but that a sufficient number of those countries had voted against the proposition to defeat it. The countries which voted negatively are Austria, Bolivia, British India, Canada, Germany, Great Britain, Guatemala, Hungary, Japan, Norway, Portugal, Russia, Spain, Sweden, Tunis, Uruguay, Venezuela.

The Academy of Natural Sciences of Philadelphia has therefore resolved to address the various scientific bodies, with which it is in communication, in those countries whose Governments have voted against the proposition, and to request those scientific bodies to memorialize their respective Governments in favor of the same. The following circular has been prepared.

The Government of   having voted in the negative, this Academy respectfully requests the favorable consideration of this question by your Society, and begs that it take such steps as it deems advisible to inform the Postal authorities of   of the manifest advantages to scientific research which would result from the adoption of the proposed modification, and to request those authorities to take such steps as may result in the adoption of the same. The letter rate for postage (Universal Postal Union) is ten times that required for samples of merchandise; such a rate for specimens of Natural History is virtually prohibitive. This Academy would respectfully urge upon your honorable Society prompt action on this matter if it meets with that approval which we so strongly desire.

President,   Recording Secretary.

As the above list of countries includes all the great powers of Europe excepting France and Italy, the necessity for the proposed action is evident.

—We have received the first number of a new geological periodical, "The Glacialist Magazine," published in London. The editorial corps includes the names of some well-known and able geologists, one of whom is an American. That this journal will be well edited we have no doubt, but we have some doubts of the propriety of adding another to the list of geological magazines now in existence. These number, in the United States alone, without counting more general scientific periodicals, five, the new one being the sixth which asks for a subscription. The probability obviously is, that unless they can be circulated gratuitously, new journals must fail of sufficient financial support. Such subscriptions as they receive are more or less likely to be withdrawn from existing journals, so that these may become impoverished. Geologists should rather concentrate than divide their publications.

—The able geologist, Mr. W. T. McGee, has been appointed Director of the Bureau of Ethnology at Washington. Mr. McGee's important contributions to Geology are well-known, and we therefore fail to see the propriety of his transfer to another field where he has been until recently unknown. We say until recently, for he has become recently unfavorably known in Anthropology for an unparliamentary review of Professor G. F. Wright's book. This appointment was, of course, made by officials who were, we suppose, unacquainted with the facts in the case. We can only say that appearances would have been saved by a greater delay in the appointment; and anthropology would have been benefited by a longer apprenticeship on the part of Mr. McGee.

Some time ago the Legislature of the State of Arkansas passed a resolution, which, declares that the pronunciation of the name of the state is Arkan*saw* and not Arkan*sas*. Persons who are in a position to know, are aware that this resolution expresses the custom of the people of the State, and of the countries immediately adjoining, while in the east and elsewhere, the name is pronounced Arkansas, so as to agree with the pronunciation of the names of the States of Texas and Kansas. These customs have been fixed for a long time, for we find in Lewis and Clark's narration of their expedition, which was published in 1823, the name spelled Arkansa. It is evident that this spelling according to the French pronunciation expresses that which long custom has made correct in English, and it therefore seems that it should be adopted in geographies and on maps, so that the confusion resulting from the pronunciation of the names Texas and Kansas may not be perpetuated. The case is quite different with regard to the native pronunciation of the name Missouri, which is Mizzoura. This is not supported by any linguistic reason, and is provincialism which time will probably abolish.

RECENT BOOKS AND PAMPHLETS.

ALLEN, H.—Introduction to a Monograph of the North American Bats.——Notes on the Genera of Vespertilionidæ. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Museum.

BLATCHLEY, W. S.—On a Collection of Batrachians and Reptiles from Mount Orizaba, Mexico, with descriptions of two new Species. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Museum.

BOURDEAU, L.—Conquête due Monde Végétal. Paris, 1893. From M. Félix Alcan, Editeur.

BAUR, G.—Das Variiren der Eidechsen-Gattung Tropidurus auf den Galapagos-Inseln. Separat-Abdruck aus der Festschrift zum siebenzigsten Geburstage Rudolf Leuckarts. Leipzig, 1892. From the author.

BRONN, H. G.—Klaussen und Ordnungen des Their-Reichs. Vierter Bd. Würmer, 1892.

Bulletin No. 90 a, and 90 b, North Carolina Agricultural Experiment Station, 1893.

Bulletin No. 30, Division of Entomology, U. S. Dept. Agricul., 1893. From the Dept. Agricul.

Bulletin No. 3, Idaho Agricultural Experiment Station, 1893.

Bulletin No. 9, New Mexico Coll. Agricultural Experiment Station, 1892.

Bulletin No. 26, Texas Agricultural Experiment Station, 1893.

Bulletin No. 20, Rhode Island College Agri. Experiment Station, 1892.

EIGENMANN, C.—Catalogue of the Fresh-Water Fishes of Central America and Southern Mexico. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Museum.

FEWKES, J. W.—A Central American Ceremony which suggests the Snake Dance of the Tusayan Villagers. Extr. Am. Anthrop, 1893. From the author.

FISHER, A. K.—The Hawks and Owls of the United States in their Relation to Agriculture. Bull. No. 3, Div. Ornith. and Mam., U. S. Dept. of Agric., Washington, 1893. From the Dept. Agric.

GAUDRY, A.—*L'Icthyosaurus burgundiæ.* Extr. Bull. Soc. d'Hist. Nat. d'Autun, T. Cinquième (année, 1892). From the author.

GILBERT, G. K.—Continental Problems. Bull. Geol. Soc. Am., Vol. IV, 1893. From the author.

GOLDI, E. A.—Zur Orientierung in der Spinnenfauna Brasiliens. Sonderabdruck aus Mitteilungen aus dem Osterlande, Neue Folge, 5 Bd. From the author.

HEDLEY, C., AND H. SUTER.—Reference List of the Land and Fresh-Water Mollusca of New Zealand. Extr. Proceeds. Linn. Soc. New South Wales. Vol. VII, 1892. From the authors.

HOLDER, C. F.—Louis Agassiz; his Life and Work. New York and London, 1893. From G. P. Putnam's Sons, Publishers.

HOLLICK, A.—The Paleontology of the Cretaceous Formation on Staten Island. Contributions from the Geol. Dept. Columbia Coll., No. 11, Extr. Trans. New York Acad. Sci., Vol. XI, No. 5, 1892. From the author.

Holmes, W. H.—Traces of Glacial Man in Ohio. Extr. Journ. Geol., Vol. I, 1893. From the author.

Klinckowstrom, A.—Untersuchungen über den Scheitelfleck bei Embryonen einiger Schwimmvögel. Abdruck Zool. Jahrb., Bd. 5 Abth. f. Morphol. From the author.

Lankester, E. R.—Contributions to the Knowledge of Rhabdopleura and Amphioxus. London, 1889. From the author.

McCormick, L. M.—Descriptive List of the Fishes of Lorain Co., Ohio. Laboratory Bull. No. 2, Oberlin Coll. From the author.

Meek, S. E.—Report upon the Fishes of Ohio, based upon observations and collections made during 1889, 1890, and 1891. Extr. Bull. U. S. Fish Comm. for 1890. From the author.

Montandon, A. L.—Notes on American Hemiptera heteroptera. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Museum.

Museum Hand-books of the Manchester Museum, Owen's College. Catalogue of the Type Fossils. Outline Classification of the Animal Kingdom; Outline Classification of the Vegetable Kingdom. Manchester, 1893. From the Museum.

Nutting, C. C.—Report on Zoological Explorations on the Saskatchewan River. Extr. Bull. Laboratories Nat. Hist., Iowa State University, Jan., 1893. From the author.

Osborn, H.—Report on Experiments and Studies in Entomology. Extr. Bull. No. 19, Iowa Exper. Station, 1892. From the author.

Packard, A. S.—Studies on the Life History of some Bombycine Moths, with Notes on the Setæ and Spines of Certain Species. Extr. Ann. N. Y. Acad. Sci., Vol. VIII, 1893. From the author.

Pettee, J. T.—A Review of the year 1892. Annual Address before the Meriden Scientific Association. From the author.

Pilling, J. C.—Bibliography of the Athapascan Languages. Issued by the Bureau of Ethnology, Smithsonian Institution, 1892. From the Smithsonian Institution.

Price, R. H.—Black Rot of the Grape. Extr. Bull. No. 23, Texas Agricul. Station. From the author.

Prospectus of a Monograph of the Birds of Paradise, and the Bower-Birds, by R. Bowdler Sharp. London, 1892. From H. H. Sotheran & Co., Pub.

Ries, H.—Notes on the Clays of New York State and their Economic Value. Extr. Trans. New York Acad. Sci., Vol. XII, 1892. From the author.

Ryder, J. A.—The Principle of the Conservation of Energy in Biological Evolution. A Reclamation and Critique. Extr. Proceeds. Phila. Acad. Sci., 1892. From the author.

Schmidt, L.—Untersuchungen zur Kenntniss des Wirbelbaues von Amia calva. Inaugural Dissertation der Math. und Naturw. Fakultät Kaiser-Wilhelms Universität Strassburg zur Erlangen der Doctorwürde, Leipzig, 1892. From the author.

Scott, W. B.—A Revision of the North American Creodonta, with notes on some Genera which have been referred to that group. Extr. Phila. Acad., 1892. From the author.

SCUDDER, S. H.—Brief Guide to the Common Butterflies of the Northern United States and Canada. New York, 1893. From Henry Holt & Co., Pub.

Seventeenth Annual Catalogue of the Agricultural and Mechanical College of Texas. Session 1892–93. From the College.

SHUFELDT, R. W.—A Study of the Fossil Avifauna of the Equus Beds of the Oregon Desert. Extr. Journ. Phila. Acad., Vol. IX. From the author.

SMITH, J. P.—Die Jurabildungen des Kahlberges bei Echte. Inaugural-Dissertation zur Erlangung der philosophischen Doctorwürde an der George-Augusts-Universität. Sonderabdruck aus dem Jahrbuch de. königl. Preuss. geologischen Landesanstalt und Bergakademie zu Berlin für das Jahr 1891. From the author.

STANTON, T. W.—The Faunas of the Shasta and Chico Formations. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

STILES, C. W.—Notes on Parasites. Extr. Journ. Comp. Med. and Veter. Arch., 1892. From the author.

STOKES, A. C.—Analytical Keys to the Genera and Species of the Fresh-Water Algae and the Desmidieæ of the United States. Portland, Conn., 1893. From the author.

UPHAM, W.—Eskers near Rochester, N. Y. Extr. Proceeds. Rochester Acad. Sci., Vol. II, 1893. From the author.

WEBER, M.—Zoologische Ergebnisse einer Reise in Nederländisch Ost-Indien. Zweiter Bd. Zweites Heft. Leiden, 1892.

WICKERSHAM, J.—Is it "Mt. Tacoma" or "Rainier?" Extr. Proceeds. Tacoma Acad. Sci., 1893. From the author.

RECENT LITERATURE.

Iowa Geological Survey.[1]— The first annual report of the Iowa Geological Survey just issued is unusually attractive in appearance, and presents an interesting array of papers. That by Professor Calvin deals with some phases, of the, as yet, imperfectly known Cretaceous deposits occurring in Woodbury and Plymouth counties, and contributes important information concerning them. These deposits in the area studied consist of soft sandstone interstratified with bands of ferruginous nodules and variegated, often parti-colored, clays, overlaid by white, or yellowish chalk, in part indurated into beds of soft fissile limestone. White, in his report of 1870, termed this chalk the Inoceramus bed, from the great numbers of *Inoceramus problematicus* found in it, while the lower beds were called the Woodbury sandstone and shales. Professor Calvin, mainly on paleontological evidence, separates the latter into two divisions, the lower of which, chiefly sandstones containing impressions of leaves belonging to species of plants resembling our modern forest trees and with animal remains exceedingly scarce, he correlates with the Dakota group of Meek and Hayden. The second division, principally shales containing impressions of valves of marine molluscs associated with the vertebræ of bony fishes and the skeletons of marine saurians, is the Fort Benton group of the same authors, while the chalk represents their Niobrara group. The few molluscan remains found in the beds of the Dakota group are related to brackish water species and imply that the beds were laid down in an estuary, or at least in a region where the sea was shallow and large volumes of fresh water were poured into it.

The beds of the second division show a gradual change in the conditions of deposition owing to the deepening of the sea and the shifting of shore line farther east. True marine molluscs, and fishes and reptiles occupied the region, and left their skeletons to be buried in the finer mud that characterized the deposits then slowly accumulating in the open sea.

During the succeeding epoch where the chalk and shell-bearing limestones were forming, the water, by subsidence of the ocean bed, had become deeper, and the shore-line of the Cretaceous sea attained its farthest extension eastward probably reaching as far as the Mississippi in northwestern Iowa. Inoceramus multiplied over the sea bottom as oysters, if undisturbed, would crowd a modern oyster bed. Sharks disputed possession with the bony fishes and marine saurians. Everything betokens a deep, clear, open sea that spread away from the shore line in Iowa, over all the intervening plain, to the present site of the Rocky Mountains. Recent excavations and cuttings have shed much light on the Iowa Cretaceous and the present survey which will doubtless add much to our knowledge of this important group of rocks, There are two formations in Iowa, probably belonging to the Cretaceous, whose exact stratigraphical relations are at present doubtful, viz.; the Fort Dodge gypsum deposits and the Nishuabrtua sandstone.

---

[1] First Annual Report for 1892, with Accompanying Papers. 8vo. 472 pp. with ten plates and twenty-six figures. Samuel Calvin, State Geologist, Des Moines, 1893.

The assistant state geologist, C. R. Keyes, contributes several papers the most important of which is on the classification of the Iowa formations. While in large part merely a summary of the work done upon these rocks in recent years by various workers, it also presents someimportant considerations derived from the author's personal investigations In the revision of the classification, some needed changes in nomenclature appear, as St. Croix for Potsdam, Oneota for Lower Magnesian, etc. The attempt to correlate the Iowa rocks with the New York section is wisely abandoned. In the classification of the Lower Carboniferous, the formations included between the Kinderhook below and the St. Louis beds above are grouped together under the term Augusta. These beds comprise what Williams[2] called the Osage group, a name here shown to be inapplicable.

It is in his discussion of the Coal Measures, however, that the author departs most widely from the generally accepted views of Iowa geology. After some general considerations of the Coal Measure deposits, he calls attention to the two classes of sediments generally recognized, viz.; marginal or shore deposits, and those laid down in the open sea. In the Coal measures, as elsewhere, the first of these is characterized by rocks predominantly clay, shales and sandstones with practically no limestones. The sandstones often form great lenticular masses, sometimes deeply channelled on the upper surface, the excavations being filled with Coal Measure clays. These and many other phenomena attest a constantly shifting shore line and the shallow waters. The fossils are nearly all brackish water forms or shore species. On the other hand, the second class of deposits above mentioned is made up largely of calcareous shales with heavy beds of limestone. The former are chiefly composed of strictly open sea forms.

---

[2] H. S. Williams, Bul. U. S. Geol. Surv., No. 80, p. 109.

As the conditions of deposition were evidently those of a slowly sinking sea shore, the marginal deposits or Lower Coal Measures practically underlie the open sea formations or the Upper Coal Measures. Hence in the use of the terms Lower and Upper, though allowable in a general way, it must be remembered that along any particular plane the two series of deposits are contemporaneous and their separation therefore would be represented by an oblique rather than a horizontal plane. Under this view the author proposes to divide the Coal Measures or Pennsylvanian series into (1) the Des Moines stage, representing the marginal deposits, thus including all the coal, and (2) the Missouri stage representing the marine deposits. These correspond essentially with the Lower and Upper Coal Measures as ordinarily given. The coal seams are shown to have but a limited extent generally, and to be nearly worthless for correlation purposes. The seams vary from a few inches to seven or eight, and even ten feet in thickness, the average of the seams now worked being between four and five feet. They are not disposed in continuous layers over the whole area as commonly supposed, but in numerous lenticular masses from a few yards to several miles in extent. Being confined to the marginal areas they are associated principally with the sediments characterizing that class of deposits, and have a slight seaward slope. They were laid down over an ancient eroded surface with hills and vales, ridges and gorges, and overlap Lower Carboniferous, Devonian, and even Silurian rocks. The paper is illustrated with numerous figures and diagrams showing graphically the structure of the Iowa coal field, and the essential differences between the views here advanced and those commonly held.

Other papers of value are presented by S. W. Beyer, H. F. Barie and G. L. Houser. That of Mr. Beyer treats of an interesting discovery of eruptive rock in a deep well at Hull, Iowa, at a depth of seven hundred and fifty-five feet, interstratified with beds of sandstone constituting what was considered to be Sioux Quartzite.

Additional facts bearing upon this occurrence of eruptive rocks in Iowa will be looked for with interest.

As a whole the report shows marked wideness of taste and care in its makeup, though the proof reader evidently mislaid his glasses at certain points, or was it the typo who failed to note the corrections?

C. H. G.

Correlation Papers—The Newark System.[3]—This essay, prepared by Mr. I. C. Russell as a bulletin, is the sixth of the series of

---

[3] Bulletin of the United States Geological Survey, No. 85. Correlation Papers—The Newark System. By I. C. Russell, Washington, 1892.

Correlation Papers issued by the U. S. Geological Survey. Originally Mr. Russell intended to cover the entire Jura-Trias of North America, but circumstances compelled him to restrict his attention to those of the Atlantic border. This particular body of rocks the author calls the Newark System, a name proposed by W. C. Redfield in 1856, giving as a reason that it is the oldest specific title not implying opinion as to geologic age. These rocks extend from North Carolina to New Brunswick and Nova Scotia, but not to Prince Edward's Island, as has been asserted. They occur in narrow belts trending parallel to the application folds, covering an area of 10,000 square miles. It is Mr. J. Russell's opinion that the evidence now at hand bears out the theory that these detached areas are remnants of a once broad terrace which has been broken by orographic movements and greatly eroded.

The sedimentary rocks of the Newark System, consisting chiefly of sandstone and shale, were deposited in tide-swept estuaries, while the carbonaceous shales and coal seams originated in basins more shut off from the seas. The trap rocks are a part of the great system of dikes and sheets which intersect the surrounding crystalline and paleozoic rocks. The evidence of glacial action during the Newark period, Mr. Russell thinks is weak.

In discussing the relations of the Newark system to other terranes the author refers to the difficulty of correlating the rocks of America with those of other countries, and concludes that biological phenomena as a means of correlating, can be safely used only after the relative age of the strata has been determined from physical phenomena. Paleontologists of the Vertebrata will not concur in this view, for the vertebrate fossils indicate conclusively that the formation contains at least the representation of the upper member of the Trias or the Keuper. This was first definitely pointed out by E. D. Cope in 1866.[4]

The volume is accompanied by a very full bibliography, and is illustrated by many handsomely executed colored and uncolored plates. The colors of the geological maps are in general accordance with those in use by geologists.

Spalding's Guide to the Study of Common Plants.[5]—It is a pleasant thing to take up a new book and find our expectations not disappointed. The author of the little work before us has for many years been a successful teacher of Botany in one of our great State Universities, and has had not only the experience which his own teaching has brought him, but he has seen much of the results of botanical teaching in the high schools which annually send up their graduates to the University. The book is intended for use in such preparatory schools and was prepared in answer to frequent inquiries from high school teachers.

---

[4] Proceedings of The Philadelphia Academy, pp. 249–50, 290. This reference is omitted by Mr. Russell from his table of determinations on p. 17, but is included in the Bibliography on p. 170.

[5] An introduction to Botany. By Volney M. Spalding, Professor of Botany in the University of Michigan. Boston, U. S. A. D. C. Heath & Co., Publishers, 1893, pp. XIII 246.

The leading thought in the book may be gathered from the following sentence in the chapter addressed to the teacher. "In order to use these exercises successfully it will be necessary to adopt the laboratory as distinguished from the text-book method of instruction."

Two short chapters are given to the discussion of the proper outfit for a botanical laboratory for high schools.

One of these includes lists of works of reference under several heads: "Laboratory Manaels," "Structural and Physiological," "Morphological and Systematic," "Floras," "Cryptogamic Botany," "General," and "Current Literature." The lists are well made and the author well says the books named "ought to have a place in any respectable school library."

The other chapter under this head gives good suggestions about the laboratory itself, the tables, microscope (small "Continental" stands recommended), glassware, regents, etc.

Then follow laboratory studies of seeds, growth of plants from the seed, root, leaf, flower and fruits. These serve to train the pupil to close observation. He then takes up the careful study of plants representing the natural groups of the vegetable kingdom. Thus the "Seaweeds and their Allies" are represented by pond scum (*Spirogyra*) and green felt (*Vaucheria*); mosses and liverworts are taken next, followed by ferns, horsetails, club-mosses, the pine family, the grass family, etc., though Monocotyledons and Dicotyledons, ending with the Compositæ. The treatment reminds one of that in Arthur, Barnes and Coulter's "Plant Dissection," of course much simplified.

The author has adopted a modification of Eichler's sequence of the families of the flowering plants . Very properly, too, he makes a distinction between "families" and "orders" (. 241).

The book will, if used by our high schools, do much to improve the quality of botanical teachings below the colleges and doubtless will stimulate some of our colleges also to better work than they have been doing.

CHARLES E. BESSEY.

Annual Report of the United States Geological Survey, 1889-90. Part I.[6]—This quarto volume of 757 pages constitutes a record of the geological work of the survey for the years 1889-90. It comprises the report of the Director, giving a general account of the progress of the work during those years, appended to which are the administrative reports of the chiefs of branches and divisions, and two scientific papers by members of the survey. Both of these papers, the first by Mr. W. J. McGee on the Geology of Northeastern Iowa, and the second by Mr. A. J. Phinney, on Natural Gas Districts in Indiana, are the result of observations extending through a number of years.

The illustrations are numerous and excellent.

The Report of the Death Valley Expedition.[7]—This report is No. 7, of the series "North American Fauna" published by the U. S. Agricultural Department. It embraces the following special reports. Birds by Dr. A. K. Fisher; Reptiles and Batrachians by Dr. Leonard Stejneger; Fishes by Dr. C. H. Gilbert: Insects by Dr. C. V. Riley assisted by Drs. S. W. Williston, P. R. Uhler and Lawrence Bruner; Molluscs by Dr. R. E. C. Stearns; Desert Trees and Shrubs by Dr. C. H. Merriam; Desert Cactuses and Yuccas by Dr. C. H. Merriam; and the Localities by T. S. Palmer.

The expedition was under the direction of Dr. C. H. Merriam, Director of the Department of Animal Industry, who deserves much credit for the inception and execution of the plan. As a report of a single exploration, it is second to none of those sent out at various times by the Government, if thoroughness of work and importance of results to geographic, climatic, and hypsometric distribution be considered. The report on Mammalia which is yet to be issued, will be by Dr. Merriam, and we may anticipate that much of interest will be brought to light by its author, who is here in his favorite field.

The geographic distribution of the numerous species met with, is stated in terms of the system already adopted by Dr. Merriam in his report on the distribution of life in Arizona.

In this system Dr. Merriam[8] discards the usual divisions, which were first proposed by Baird, added to by Cope, and divided by Verrill and Allen, which correspond in great measure with the geological divisions of the continent, and which are in part divided by lines approximately meridianal. He regards the primary faunal divisions as corresponding in great measure with parallels of latitude. Thus his Sonoran region includes the Sonoran and Austroriparian of Cope, which thus extends from the Pacific to the Atlantic Ocean. But he recognizes the two divisions as of distinct though subordinate value, calling them respectively, the arid and humid districts. He does not adopt the Pacific nor the central regions. Dr. Merriam admits that his system does not express the relations of the aquatic vertebrates. But a system which does not take these into account must be defective. Moreover it is not difficult to show that the Batrachia and Reptilia as well as the fishes sustain the system of Baird and Cope, and Dr. J. A. Allen has shown in a review of Dr. Merriam's paper (published in the Auk) that the birds do also. The geologic history of the continent has had everything to do with the origin of this distribution of life, so that the system which conforms to it is likely to be the correct one.

---

[6] Eleventh Annual Report of the United States Geological Survey to the Secretary of the Interior, 1889-90. By J. W. Powell, Director, Part I, Geology, Washington, 1891.

[7] The Death Valley Expedition: A Biological Survey of parts of California, Nevada, Arizona and Utah. Part II, North American Fauna, No. 7. Washington, 1893.

[8] The Geographic Distribution of Life in North America with special Reference to the Mammalia; Proc. Biol. Soc., Washington, VII, p. 11. April, 1892.

In regard to the birds observed during the Death Valley Expedition of 1891, Mr. A. K. Fisher writes as follows:

"Baird's woodpecker (*Dryobates scalaris bairdii*) was quite common among the tree yuccas on the Mohave Desert at Hesperia, and its range was extended northward to Vegas Valley, Nevada, and the valley of the Santa Clara, in southwestern Utah, by Dr. Merriam. The vermillion fly-catcher also was secured in the same valley, though previously unknown north of Fort Mohave, Arizona. The Texas nighthawk (*Chordeiles texensis*) was found to be a common summer resident in all the valleys east of the Sierra Nevada from Owens Valley, California, to St. George, Utah, where Dr. Merriam secured the eggs. It was taken also in the San Joaquin Valley, California, near Bakersfield. Scott's oriole (*Icterus parisorum*) is another species whose range was carried northward from a short distance above our southern border in California to about latitude 38°, where it was common in places among the tree yuccas, and also on the slopes of some of the desert ranges as high as the junipers and piñons. Costa's humming-bird (*Claypte costæ*) was very common whever water occurred throughout the desert region, ranging northward nearly to latitude 38°, and eastward to the Beaverdam Mountains, Utah. Its nest was frequently found in the low bushes and cactuses on the hill sides near springs and streams.

"The discovery that the gray-crowned finch (*Leucosticte tephrocotis*) breeds in the southern Sierra and in the White Mountains is especially interesting both because its breeding range was previously unknown, and because no species of the genus had been recorded from the Sierra Nevada south of about latitude 40°, while the present species was common nearly to the 36th parallel.

"Most satisfactory results were accomplished in working out the distribution of Thurber's junco (*Junco hyemalis thurberi*) a recently described race whose range was not definitely known. In the Sierra Nevada it was common from the Yosemite Valley, the most northern point visited by any member of the expedition, to the southern end of the range, and in the desert ranges eastward to the Grapevine and Charleston Mountains, where its place was occupied, in winter, at least, by its more eastern representative, Shufeldt's junco. The little black-chinned sparrow (*Spizella atrigularis*) was found to be not an uncommon summer resident on the slopes of several of the desert ranges and also on the east slope of the Sierra Nevada as far north as Independence Creek in Kearsarge Pass. This was a great surprise, as heretofore the species has been recorded within our limits only along the southern border, and its presence was not suspected, until a specimen was taken in the Panamint Mountains in April.

"Le Conte's thrasher (*Harporhynchus lecontei*) contrary to our expectations, was a common resident throughout the principal desert valleys from Owens Valley at the east foot of the Sierra Nevada across southern California and Nevada to southwestern Utah, where it was found nearly to the summit of the Beaverdam Mountains." Its range was found to correspond nearly with that of the curious bush *Larrea mexicana* in our limits.

An interesting result is the discovery that the California condor (*Cathartes californianus*) is not so rare nor so near to extinction as has been supposed. A considerable number of individuals were seen by members of the expedition, mostly on the eastern side of the southern Sierra Nevada. Now that bisulphide of carbon is taking the place of strychnia for the destruction of mammalian pests of agriculture, it is to be hoped that the slaughter of this magnificent bird will be stopped, and that it will continue to add dignity to the noble scenery in which it dwells, as long as the country itself continues.

The determinations and descriptions of the Reptilia and Batrachia of this report are the work of Dr. Stejneger of the U. S. National Museum, and they are accompanied by field notes by Dr. C. H. Merriam. In the work of Dr. Stejneger, we see the ornithologist in herpetology. The critical quality of the work both as to the structural characters, and the literature, is beyond all praise; but species splitting is carried to a length hitherto unknown in the science, and the nomenclature is reduced to a system which takes in all names, provided they got printed, no matter how.

The identification of some of Baird and Girard's type specimens, and hence species, is a service for which herpetologists will be grateful, and Dr. Stejneger places in the hands of naturalists the means of determining their value. That they will often disagree with his conclusions as to species, is to be expected. Thus by his own showing *Sceloporus magister* is not a different species from *S. clarkii*, although he thinks it is; nor *Hypsiglena texana* Stejneger sp. nov. from *H. ochrorhynchus*; nor *Bufo halophilus* from *B. columbiensis*. I have examined the series of Crotaphytes in the National Museum with the view of ascertaining the standing of the recently described *C. baileyi* Stejn. and *C. silus* Stejn., and I cannot see in them more than poorly defined local races of the *C. collaris* and *C. wislizenii* respectively. The same is true of *Callisaurus ventralis* Hallow., as compared with *C. dracontoides*. In nomenclature, we have all the nomina nuda of Fitzinger revived, and all the unclassical spellings of original authors carefully preserved. Thus we find Pituophis for Pityophis, Bascanion for Bascanium, and bi-seriatus for biseriatus. Such acumen directed to the proper spelling of names would be a material gain to science in this country.

Forty-four species of Reptiles were procured by the expedition, and twelve species of Batrachia. None of them are regarded as new[9] to science excepting a Rana, which is called *Rana fischerii*. This appears to be very close to the *R. onca*, with which it should be further compared. The notes on the habits of the species by Dr. Merriam are very interesting and add much to the value of the paper. Before passing to the fishes, I pause to correct a misapprehension into which Dr. Stejneger has fallen, and which involves the veracity of the writer of this review. In adopting the name *pipiens* for the *Rana virescens*, he remarks that Garman has shown that the former is the correct name, and that he is therefore not responsible "as one might be led to believe from Cope's treatment of the matter," for the use of the second name (*virescens*). The paragraphs in which the reasons for the employment of the name *virescens* are set forth in my Batrachia of North America, were copied directly from MS. furnished me by Mr. Garman. Mr. Garman changed his mind after the publication of my book.

The region explored is not rich in fishes, but a good many specimens and species were obtained. The most important result is the discovery of a new species of Cyprinodontidæ which is nearly related to the Oristias of the elevated Lake Titicaca of Peru, which is the type of a new genus called by Professor Gilbert, Empetrichthys. As in the Peruvian genus there are no ventral fins and no lateral line, and the very large pharyngeal bones are fused below. This fish inhabits the inhospitable waters of the Amargosa River, which, while not elevated like the Peruvian lake, flows through a region of similar geologic age. Another interesting discovery is that of the rare *Lepidomeda vittata* in a stream on the western side of the Colorado drainage in Nevada, far from the only locality previously known, which is the Colorado Chiquito of Arizona on the eastern drainage.

---

[9] The new species described in the report are from adjacent regions.

In an introduction to the report on insects, Mr. Riley makes the following remarks:

"Taking first the Coleoptera, which represent by far the larger part of the collectings, they have for the most part been carefully compared with the national collection, and I have had the assistance, in the verifications, of Mr. M. S. Linell and Mr. E. A. Schwartz, both well acquainted with our North American Coleoptera. As the chief localities from which the beetles were obtained do not exceed seven, the list has been arranged in tabular series to prevent repetition of localities. This arrangement at once shows that the collection comprises some 258 species, representing 170 genera in 39 families. Of the total number of species arranged according to localities, twenty-eight (a) are of general distribution in North America, i. e., they cross the whole continent, and among them are six cosmopolitan species, while only a single species *Bradycellus cognatus* found in the Argus Mountains, belongs to the circumpolar fauna. About fifty of the species are widely distributed throughout the more arid regions of the west, and about twenty species belong more properly to the fauna of maritime or upper California. The bulk of these species, as will be noted, were collected in San Bernardino County. Deducting the three sets of species and a few others, e. g., the genera Homalota, Scopæus, Scymnus and Cryptophagus, of the distribution of which very little can be definitely said, there remain about 140 species which are more or less characteristic of the Sonoran fauna. Some nineteen species are undoubtedly new.

"In the Heteroptera the list represents merely the species that were readily determinable, while the balance, including the more interesting forms, have been referred to Mr. P. R. Uhler, of Baltimore, Maryland, who has kindly reported on them, with definitions of the new genera and species.

"In the Homoptera, as will be noticed, there are some interesting new species, especially in the family Psyllidæ, but until they are carefully compared I do not feel justified in making any remarks upon them, nor have I time just now to characterize the undetermined forms which I prefer to do in connection with the very many new species in the National Collection to which I have already given much study."

Mr. S. W. Williston prefaces a report on the Diptera as follows:

"That the larger part of the collection of Diptera from Death Valley and the adjoining regions sent me for determination by Professor Riley should be new to science is not strange, inasmuch as they are, for the greater part, members of families which have been but little studied in America. The collection is of considerable interest as adding three European or African genera hitherto unrecorded from America, among which the wingless Apterina is the most remarkable. After a careful search I have found it necessary to describe two new genera —one among the Dexiidæ, the other an Ephydrinid."

The Land and Fresh Water Shells were examined and reported on by Mr. Robert E. C. Stearns, who refers to the more important ones in the following language.

"The more interesting forms obtained were the two species heretofore referred to Tryonia, until recently regarded as obsolescent or absolutely extinct, but which were found to be living, as elsewhere remarked. *Helix magdalenensis*, another interesting species described from examples collected in the Mexican State of Sonora in 1889-90 by Mr. Bailey, of Dr. Merriam's Division of Biological Exploration, was detected by Fisher and Nelson several degrees of latitude farther to the north than the habitat of Bailey's original examples and at a very much higher altitude. This latter, by its presence at this northerly station, contributes to our previous knowledge and data bearing upon the relations between the geographical distribution of species and environmental conditions or influences; and two fresh water forms, not before known, were added to the Molluscan fauna of the region traversed by the expedition."

This report is one of the valuable results of the establishment of the Division of Animal Industry of the Agricultural Department. We hope that the recent reductions in the force of the Department by the present Secretary has not affected the efficiency of the Division, as science in general and Agriculture in some of its aspects, would materially suffer.—E. D. COPE.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Laurentian of the Ottawa District.—In a paper recently published by Mr. R. W. Ells, the author shows that certain modifications of the arrangement of the Laurentian strata as laid down in the geological map of Canada, 1866, must be made. While it is as yet hardly possible to estimate correctly the thickness of the strata, there is no doubt that it has been overstated. The Anorthosite masses north of St. Jerome which had been placed in the upper Laurentian have been shown by Dr. F. D. Adams to be of intrusive origin. The limestones in both the Trembling Mountain section and the region between the Anorthosite area and Gatineau River in nearly every case occupy well defined synclinals.

The succession of strata in ascending order as revised by Mr. Ells is as follows:

1. Reddish-gray gneiss without distinct signs of bedding.
2. Reddish orthoclase gneiss showing a well stratified arrangement of beds.
3. Grayish and rusty gneiss passing into a regular crystalline limestone.
4. A series of schistose rocks, highly metamorphic, described in earlier reports as the Hastings series.

In conclusion the author calls attention to the fact that under the present arrangement of the Laurentian of Quebec the parallelism with the rocks of the system as displayed in southern New Brunswick is very close. (Bull. Geol. Soc. Am., 1893.)

Relations of the Laurentian and Huronian Rocks North of Lake Huron.—This paper is an extension of one published by the author, Mr. A. E. Barlow, in 1890, and contains some further observations on the nature of the contact between the Huronian rocks of Lake Huron, described by Logan and Murray, and the Laurentian gneisses. As a result of his investigations, Mr. Barlow is convinced of the irruptive nature of this Laurentian gneiss and of its magmatic condition at a time subsequent to the petrification of the Huronian sediments. The following facts have led to this conclusion:— (1) The diverse stratigraphic relations of the two rocks along their line of junction. (2) The alteration of the sedimentary rocks along the line of junction. (3) The inclusion of angular fragments in the mass of the gneiss which are clearly referable to the adjacent sedimentary strata. (4) The occurrence of gneissic intrusions distinctly irruptive. (5) The absence of limestones, slates or quartzites, or any species of rocks indicative of ordinary sedimentation. (6) The general character of the rock itself. (Bull. Geol. Soc. Am., 1893.)

The Carboniferous Glaciers of Central France.—In a note on the geogeny and stratigraphy of the coal-measures of central France, M. A. Julien discusses the various problems to whose solution the key is given by the discovery of the glacial origin of the breccia in the coal-measures: (1) the cause of the glaciers of the coal-measures; (2) their centers of dispersions; (3) the direction of the glaciers for each basin; (4) the precise relative age of the breccia.

The cause of the glaciers is the elevation, at the beginning of the Upper Carboniferous period, of Alpine masses forming part of that chain which Mr. Marcel Bertrand designated, a few years since, the Hercynian chain. The formation of this chain caused the elevation of central and western Europe and displaced the carboniferous ocean as the Alpine chain, at the close of the Miocene epoch, expelled the Helvetian sea. In both cases these extensive orogenetic movements were accompanied by an enormous development of the internal activity of the globe resulting in the breaking out in Europe of that series of porphyritic volcanoes of the Permo-carboniferous epoch, and of trachytic and basaltic eruptions toward the close of the Tertiary. It is not, then, at all strange to find traces of Permian and Carboniferous glaciers since the conditions which produced the more recent glaciers were present also during those earlier periods.

With the aid of a careful lithological inventory of each basin, one can infer the height of the original mass, and the direction of the flow of the glaciers. For instance, those entering the basin of St. Etienne came from the north.

In regard to the relative age of the breccia, the author concludes that the Coal-measures of the basins of Epinac, Blauzy, Brassac, Langeac, Commentry, etc., are synchronous, that their formation has been simultaneous, and that they differ from each other only in having their upper beds more or less worn down by erosion.

M. Julien is thus led to synchronize, in spite of conflicting floral testimony stated by M. Grand 'Eury, the beds of Rive-de Gier, Valfleury and Fouillouse, those of Epinac, Colombier, and Marais, at Commentry, of Combelle and of Chalède in the basins of Brassac and of Langeac all of which were in existence before the glacial formation in its maximum extension. For similar reasons, he synchronizes also the upper beds in the great sterile plain, such as those of St. Etienne, Grand-Moloy, and Sully, those of Blauzy, the upper bed of breccia of the Carboniferous terrain of Meaulne, and the beds of Brassac and of Marsange.

M. Julien also considers the extensive bed of Commentry parallel with the three divisions of St. Etienne (Revue Scientifique, Sept., 1893).

Quicksilver Ore Deposits.—An important paper by George F. Becker, intended for the use of mining engineers. The first section treats of data from observation, the second of theoretical inferences as to the transportation and precipitation of the ore and of the form of the deposits. In this connection the recent advances in the study of osmosis is pointed out. In closing, the author gives a brief résumé of recent developments in various parts of the world, in which he embodies the results of the investigations of Professor A. Schrauf on Idria and Mr. P. de Ferrari, on the mines of Monte Amiata.

Statistical tables accompany the paper compiled from Monograph XIII of the U. S. Geological Survey. (Extract from Mineral Resources of the United States, Calendar Year, 1892.)

The Discovery of Miocene Amphisbænians.—No fossil remains of Amphisbænians so far have been made known. Mr. J. B. Hatcher, so well known to paleontologists, had the good fortune this summer to procure two small Lacertilian skulls, in the White River Beds of South Dakota, which when shown to me, I at once recognized as belonging to the Amphisbænians. Professor W. B. Scott of Princeton College, for which Institution the collections were made by Mr. Hatcher, had the great kindness to allow me the publication of this very interesting find; and I give to-day a short description of the principal characters of the skulls, which will be followed soon by a full account with figures.

1. The larger skull, which measures 13 mm., from the middle portion of the condyle to the anterior end of the premaxillary, and 5½ mm. at its transverse diameter between the posterior ends of the maxillaries is so close to Rhineura Cope, from Florida, that I am not able to place it with the present material in another genus.

The nostrils are inferior in position. The single premaxillary is widely separated from the frontals by the large nasals, which are distinct, and extend to the border of the muzzle, overroofing the nostrils. The prefrontal is large, placed between parietal, frontal, and maxillary, forming the superior border of the orbit; the jugal is exceedingly rudimentary, only connected with the maxillary; there is in all living Amphisbænians no postorbital arch. The squamosal is not free. One tooth on premaxillary, 6 pointed teeth on each maxillary. It is distinguished from the modern *Rhineura floridana* Baird, by the more slender form of the skull, and may be called *Rhineura hatcherii.*

2. The smaller skull measures only 10 by 5½ mm. It is at once distinguished from all living Amphisbænians by the presence of a postorbital arch, and the very peculiar prefrontal.

The nostrils are inferior in position. The single premaxillary nearly touches the paired frontals behind. Premaxillary, nasals, frontals nearly meeting in one point. The nasals are distinct and extend to the border of the muzzle, over-roofing the nostrils. Prefrontal very small, placed between maxillary and frontal; separated from the orbit by a descending process of the frontal, which forms the anterior border of the orbit. Jugal complete forming a distinct postorbital bar; it is in connction with maxillary, frontal, and parietal. Squamosal well developed and free. One small tooth on premaxillary and 4 on each maxillary.

This form represents a new genus and a new family of the Amphisbænians, which may be called HYPORHINA and HYPORHINIDAE. The species may be named *Hyporhina antiqua.*—G. BAUR.

Walker Museum, The University of Chicago.

On Symmorium, and the Position of the Cladodont Sharks.—In a paper recently read before the Philadelphia Academy I have described a shark from the Coal measures of Illinois under the name of *Symmorium reniforme.* The genus Symmorium is a Cladodont which differs from *Cladodus* Agass. in having the axial elements of the pectoral fin fused with each other and with the proximal basilar elements, into a single piece.

The specimens on which this genus is founded throw much light on the structure of the Cladodont pectoral fin, and through it, on the question of the evolution of this organ among fishes. The fin basis described is mostly well preserved, and clear as to details of structure. It confirms the characters ascribed by Traquair to the pectoral fin of a Cladodus from the Lower Carboniferous of Scotland,[1] the only important difference being that in the latter the metapterygium is dis-

---

[1] Geological Magazine, Feb. 1888, p. 82.

tinctly segmented, while in the Symmorium this element forms a single piece, except possibly at the extremity. According to Traquair there is an "oblong" proximal segment of the metapterygium "whose anterior portion seems to have absorbed the bases of one or two adjacent radials." In *Symmorium reniforme*, all the basals (radials of Traquair), are fused at their bases with the metapterygium. The basals are also more numerous than in Dr. Traquair's shark, for he says "some small radials are seen attached to the preaxial side of the first two segments—none on the others." My specimen agrees with Traquair's in the absence of basals (radials) from the post-axial side of the metapterygium, where indeed they are not to be looked for.

The structure of the paired fins here pointed out, sustains the views already announced by Dr. Bashford Dean[2] in a recent paper, and this author is to be congratulated that the view which he has put forth, is so fully sustained by the material in my possession. One hypothesis which he holds requires further confirmation; viz, that the metapterygium is formed by the fusion of the basal elements. The extensive fusion seen in the later genus Symmorium as compared with the earlier genus Cladodus, supports his position so far as it goes, but the origin of the primitive metapterygium is not thus explained.

My observations on Symmorium, together with those of Traquair, Jækel, and Dean, show that the median axis of the archipterygium is not propterygial or mesapterygial, but is metapterygial. This greatly simplifies the conception of the history of the Selachian fin, where the metapterygium supports the greater number of the other segments. It shows that the Ichthyotomi are not elements in the phylogeny of the sharks,[3] but form a side branch. It is further to be observed that the essential distinction now discovered between the metapterygial and other elements of the paired fins, must be maintained in our future studies of them. A clear distinction between baseosts and axonosts in the paired fins has been hitherto wanting. For the present it may be convenient to regard the metapterygial elements as axonosts, and those which have originally been branches of that axis, as baseosts. The scapular base of the Selachian fin consists then of one axonost and two baseosts. The typical Actinopterygian fin will have as its scapular base, according to Gegenbaur's homologies, baseosts only, the metapterygial (axonost) elements having entirely disappeared.

It results from the preceding observations that the Cladodontidæ must be removed from the Ichthyotomi where Dr. Woodward placed them, and be relegated to his order of Acanthodii. The definitions of the three orders of Elasmobranchii derived from the fins, will then be as follows; those of the second and third being the same as given by me in the NATURALIST for 1889, (October, p. 854).

---

[2] Transac. N. York Academy of Sciences, 1893, April, p. 124:

[3] See Proceeds. Am. Philos. Soc., 1892, p. 280.

Paired fins ptychopterygial,	*Acanthodii.*
Paired fins archipterygial,	*Ichthyotomi.*
Paired fins basilo-metapterygial,	*Selachii.*

The term ptychopterygium is introduced to describe the paired fins of the Acanthodii, in which the basilar or radial elements spring directly from the body wall; the axial elements when present, being within the body wall. This structure is primitive, and sustains the view of Thacher, that the paired fins have originated from a lateral fold.—E. D. COPE.

Geological News.—Paleozoic.—During a recent geological exploration in the neighborhood of Mount Lambie in New South Wales, Messrs E. F. Pittman and T. W. E. David found several specimens of *Lepidodendron australe* in rocks of true Devonian age. This is an interesting discovery since, although surmised, it is a fact which has not hitherto been proved. (Proceeds. Linn. Soc., N. S. W., 1893.)

Among the important recent discoveries is that of fine larval trilobites in the Lower Helderberg formations south of Albany, New York. These specimens are referred by C. E. Beecher to the genera Acidaspis and Phaëthonides. They represent early stages of these genera when the animals had no thoracic segments, and when the separation between the cephalon and pygidium was not distinctly marked.

As a result of the study of these forms Mr. Beecher is confirmed in the idea suggested by Woodward and Edwards that the Trilobita may be considered as ancient or protoisopods. (Am. Journ. Sci., Aug., 1893.)

——According to Mr. C. S. Prosser the fossiliferous zone underlying the Oneonta sandstone in Chenango and Otsego Counties, New York, is not the top of the Hamilton but belongs in the Portage stage. The writer bases his opinion on faunal data. (Am. Journ. Sci., Sept., 1893.)

Mesozoic.—A femur found in 1838, at Slingaby, Yorkshire, has recently been identified by Dr. Seeley. He refers it to a small species of Omosaurus with the specific name *phillipsi.* This is the third species of this genus found in England. (Yorkshire Philosph. Soc. Report, 1892.) Mr. R. T. Hill has published a list of the invertebrate fossils collected or obtained by him from the beds of the Trinity Division in Arkansas and Texas. Of the 34 Mollusca described, 12 represent new species. The families of Foraminifera, Echinodermata, Vermes, Molluscoidea and Arthropoda have one species referred to each, of which the first only is known; the others are either indeterminate or new. (Proceeds. Biol. Soc Wash., 1893.)

The jaw of a new carnivorous Dinosaur from the Oxford Clay of Peterborough, Eng., is figured and described by Dr. Lydekker in the Quart. Journ. Geol. Soc., Aug., 1893. It is of large size and solid structure, and appears to be nearly allied to the Thecodontosauridae. It differs from the described genera of that family by the marked deflection of the mandibular symphysis. Dr. Lydekker accordingly refers it to a new genus under the name *Sarcolestes leedsii.*

Professor T. R. Jones notes the discovery of 15 fossil Ostracoda, 13 of which are new, from the Upper Cretaceous series of Wyoming and Utah. Nearly all represent either fresh water or estuarine forms. Professor Jones has described and figured these interesting specimens in the Geol. Mag., Sept., 1893.——At a recent meeting of the London Geol. Soc., Mr. E. A. Walford described some forms of Bryozoa from the spinatus zone of the Middle Lias near Banbury, Eng. The new material shows the opercular aperture, and the opercula *in situ* with appendages and supraoral ovicells characteristic of the Cheilosiomata. In addition he found giant cells (cistern cells) of form quite dissimilar from the ordinary zooecia and probably reproductive. The name Cisternophora is suggested for the genus of which several forms were described (Geol. Mag., Aug., 1893.)

Cenozoic.—Captain F. W. Hutton questions the propriety of the name, *Dinornis queenslandiæ,* given by C. W. DeVis in 1884 to a struthious femur found at King's Creek, Darling Downs. Captain Hutton is inclined to refer the fossil in question to the Casuariidæ since it possesses the posterior projection of the trochanterial surface, a character lacking in the Dinornithidæ and Apterygidæ, but present in the femora of both the Cassowary and the Emu. (Proceeds. Linn. Soc., N. S. W., 1893.)

The skull of a Lemuroid mammal found in the shell-marl in the south-west coast of Madagascar has been determined by Dr. Forsyth Major to be that of a gigantic Lemurid related to the extinct genus Adapis as well as to the existing Lemurids. The brain-case is small, the thickening of the bones of the skull is very remarkable. The tritubercular molars and premolars approach closely some Malagasy Lemurids. Dr. Major names this new form *Megaladapis madagascariensis.* (Proc. Roy. Soc., 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Trachytes and Andesites of the Siebengebirge.—In the course of a discussion on the geological relations of the trachyte and andesite of the Siebengebirge, Grosser[2] describes the various occurrences of these rocks and gives an outline of their petrographical characteristics. The trachytes he separates into typical, andesitic and aegerine varieties, and the andesites into trachytic and basaltic kinds. In the typical trachytes hornblende phenocrysts are frequent, but crystals of this mineral in the groundmass are unknown. Among the andesites the trachytic variety is noted for the absence of dark components from the groundmass and their rarity among the rock's phenocrysts. The basaltic andesite is rich in iron minerals, both as phenocrysts and as constituents of the groundmass. The order of eruption was trachyte, andesite, basalt.

A Variolitic Dyke in Ireland.—A variolitic dyke from Annalong, County Down, Ireland, resembles in the hand-specimen the variolites from Mt. Genévre. Cole[3] mentions it as consisting of devitrified glass, often containing skeleton crystals of magnetite, augite and plagioclase, and enclosing spherulites that are much larger toward the center than at the edge of the dyke. Thin selvages, 1 cm. in thickness, with very small spherulites scattered through them, exist on the sides of the dyke. Beyond these there is an abrupt transition to material containing the large spherulites. The selvages evidently cooled and lined the walls of the crevice now occupied by the dyke, before the interior filling consolidated; for not only is the transition between the substances of the two portions sharp, but the spherulites of the interior mass have in some cases grown from the line separating the two portions.

The Chemical Nature of Eruptive Rocks.—Lang[4] has returned to his study[5] of the chemical nature of eruptives. After a critical examination of many fresh specimens, the author concludes that the mineralogical nature of igneous rocks cannot be determined from their chemical composition, but that types with the same general chemical relationships possess the same general mineralogical character. The author also gives his views on the relationships existing between the various rock types, as based on their calcium and alkali ratios, and, while not so stating it, he shows that the emanations from an eruptive center are consanguinous.

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Min. u. Petrog., Mitth., xiii, p. 39.

[3] Sci. Proc. Roy. Dub. Soc., 1892, p. 511.

[4] Min. u. Petrog. Mitth., xiii, p.115.

[5] Cf. AMERICAN NATURALIST, 1892, p. 334.

Norites in the Eastern United States.—Along a shear zone in the norite of Avalanch Lake in the Adirondacks, Kemp[6] finds what he believes to be a schistose phase of the rock in which several new minerals have been developed. The massive norite consists chiefly of plagioclase, with a little hornblende, enstatite and magnetite. In the schistose rock, which is much more basic than the norite, are broken pieces of plagioclase, shreds of hypersthene, grains of green monoclinic pyroxene, pink garnet, greenish-brown hornblende, biotite and magnetite, of which both the monoclinic pyroxene and the garnet are supposed to have been produced from the hypersthene and the plagioclase of the original norite. The schist resembles an eclogite. The same writer[7] records the discovery of a new occurrence of norite or of hypersthene gabbro at Artsdalen's quarry in Bucks County, Pa. It is associated with a limestone which is the matrix of a large number of metamorphic minerals. It is thought that this limestone may be a block brought from below by the eruptive. The region surrounding the quarry is underlain by pre-Cambrian rocks, but it is almost without exposures. The occurrence of norite here is interesting as affording a link connecting the otherwise separated Baltimore and Cortland areas of basic eruptives.

The Ottrelite Conglomerate of Vermont.—Reference has already been made in these notes to the discovery of an ottrelite conglomerate[8] in the Green Mountains of Vermont. Whittle[9] has now given us in more detail the description of its occurrence, and adds to this many items of interest concerning the dynamic schists associated with it. Among other things connected with the minerals of the conglomerate he mentions the secondary enlargement of clastic tourmaline grains and describes the alteration of microcline pebbles into quartz, sericite, biotite and albite. In one microcline there are many inclusions of limonite and rhombs of siderite. As the sericite grows it clears the microcline of these, so that around each grain of the mica is a zone of pellucid feldspar, and on both sides of veins of the sericite are clear borders of microcline entirely free from inclusions of any kind.

---

[6] Amer. Journ. Sci., Aug., 1892, p. 109.

[7] Trans. N. Y. Acad. Sci., xii, p. 71.

[8] AMERICAN NATURALIST, April, 1893, p. 382.

[9] Bull. Geol. Soc. Amer., iv, p. 147.

Chalcedony and other Silicious Spherulites.—A well-illustrated article by Levy and Meunier-Chalmas[10] treats of various forms assumed by the molecule $Si\ O_2$ in the production of spherulites. Chalcedony has heretofore been regarded as a mixture of quartz and opal. The present authors have had an opportunity to study some excellent specimens of silica spherulites and concretions from the gypsum beds in the Paris Basin. Chalcedony and two new forms of silica, called by the authors quartzine and lutecite, are the components of these concretions. All three of these substances are fibrous forms of the same mineral, which is positive and biaxial, with an optical angle varying between 20°–35°. Thus they are different from quartz. The distinctions between the three varieties rest upon their habit. Chalcedony is elongated parallel to the base of the crystals, and quartzine parallel to the plane of their optical axis, while the lutecite fibers are elongated in a direction making an angle of 29° with the optical axial plane. The relation of the long axis of each variety to the optical constants of the mineral is carefully worked out, and the appearances of thin sections of their groupings are illustrated by eight beautifully executed photographs.

Petrographical News.—Andrea and Osann[11] ascribe the existence of a porphyry breccia at Dorsenheim near Heidelberg to the crushing of porphyry by faulting and the cementing together of the fragments thus made by siliceous material.

A series of high dipping crystalline schists near Salida, Col., is regarded by Cross[12] as having originated by the alteration of great flows of basic and acid lavas erupted in Algonkian time. Though the rocks are now hornblende and micaceous schists, some of them still present a few of the structural features of diabases and porphyries.

Danalite from Redruth, Cornwall.—Tetrahedra of danalite at Redruth, Cornwall, are associated with quartz and arsenopyrite. Miers[13] mentions them as projecting from a layer of massive danalite with a thickness of from a quarter to half an inch. Some of the crystals measure 30–50 mms. across. They are almandine-red in color, are translucent, and have a light pink streak, a hardness of 5.5 and a density of 3.350. An analysis gave:

---

[10] Bull. Soc. Franç d. Min., xv, p. 159.

[11] Mitth. gross. Badisch. geol. Landesanst, ii, p. 365.

[12] Col. Sci. Soc., Jan. 2, 1893.

[13] Miner. Magazine, x, p. 10.

SiO_2	FeO	MnO	ZnO	BeO	CaO	S	Total
29.48	37.53	11.23	4.87	14.17	tr	5.04	=102.62

corresponding to R.S. 7RO. $3SiO_2$.

Mirabilite Changed to Thenardite.—Two crystals of mirabilite implanted on a mass of rock-salt from Aussee, Salzkammergut, that has been in the possession of the University of Vienna six years, have, in this time, so changed that they now consist simply of a thin shell composed of a crystalline aggregate whose inner surface is completely drusy. Within this crust there is usually a hollow, but occasionally a part of the hollow may be filled by a group of crystals like those forming the shell. These crystals are determined by Pelikan[14] to be *thenardites* of a short pyramidal habit, bounded by the planes P. $\frac{1}{3}P$, $P\bar{\infty}$, $\frac{1}{3}P\breve{\infty}$ and $\infty P\breve{\infty}$, with an axial ratio of $a : b : c = .5970 : 1 : 1.2541$. The crystals had been kept during the six years in an air-tight enclosure at a nearly uniform temperature, so that the change from their original condition must have been due solely to the influence of the small amount of moisture within the enclosure.

Mineralogical News.—Crystals of the rare *uranatile* from Schneeberg, Saxony, and from the Joachimsthal, Bohemia, have been measured by Pjatnitzky,[15] who concludes that they are triclinic and not orthorhombic as Zepharovich supposed. Their axial ratio $a : b : c = .6257 : 1 : .5943$. The mineral has a citron or sulphur-yellow color, with very weak dichroism. *Uranophane*, according to the author, should not yet be considered a species. Its chemical composition is the same as that of uranatile, but its crystallization has not yet been determined.

The rare plane $2O\infty$ has been detected by Pelikan[16] on salt crystals from Stannia, Galicia. Upon examining sections of *halite* from this locality, the author discovered in them many inclusions of petroleum zonally arranged. The cavities in which the oil is contained are either pear-shaped or are negative crystals, entirely or only partially filled with the liquid, which must have been under greater pressure at the time of its imprisonment. From the distribution of these inclusions the author concludes that the crystals were first cubes, then tetrahexahedra (2O∞), and finally cubes, as at present.

---

[14] Min. u. Petrog. Mitth., 1892, xii, p. 476.

[15] Zeits. f. Kryst., xxi, 1892, p. 74.

[16] Min. u. Petrog Mitth., xii, p. 483.

Jannetaz[17] has made an analysis of the black garnet *pyreneite*, now the subject of so much discussion[18] in Europe, and has found it to consist of:

SiO_2	Al_2O_3	FeO	MgO	CaO	Total
39.4	10.0	18.6	1.0	31.21	= 100.21

It is thus neither melanite nor grossularite, but is intermediate in composition between the two. Its density is 3.7

Miers[19] has succeeded in obtaining some excellent though tiny crystals of *orpiment* by dissolving in hydrochloric acid the marl in which nodules of this substance are found at Tajowa, Hungary. Under the microscope the little crystals appear with the orthorhombic symmetry. oP is the plane of their optical axes. Their axial angle for sodium light is 70° 24′ in air.

The same mineralogist[20] has repeated Gmelius' analysis of *helvite* from Schwarzenberg, and has obtained this result:

SiO_2	FeO	MnO	BeO	Al_2O_3	CoO	S	Total
31.85	4.26	42.47	14.25	.74	3.16	4.81	= 101.54

Dumortierite is recorded by Gonnard[21] as occurring in the feldspar of a granite vein cutting the gneiss in a quarry at Ternières, Francheville, Dept. of the Rhone, France.

The same writer[22] figures a few new types of *natrolite* crystals from the Puy-de-Dôm, and describes[23] the occurrence of crystals of *analcite* in the fissures of the porphyry at Agay, Canton Hyères, France.

Brazilite, analyzed by Blomstrand,[24] has the following composition:

ZrO_2	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Alk	Loss	Total
96.52	.70	.43	.41	.55	.10	.42	.39	= 99.52

Experiments in Crystallization.—Hundt[25] has repeated Vogelsang's experiments on the crystallization of sulphur from its solution in carbon bisulphide thickened with balsam, and has discovered thereby some new facts regarding the phenomena connected with the formation of crystals. He finds the globulites aggregating into *liquid* spherules of sulphur that may remain liquid for several days. Grains of sulphur that are melted on a glass plate may also remain in a liquid condition for a long time—in some instances, three months—before they solidify. Upon agitation with the point of a needle they immediately become solid. The author declares that there is no tendency among the globulites to arrange themselves into definite groups, as Vogelsang reported to be the case. In the largest drops, however, they may take definite positions, whereupon the entire drop may be made to crystallize by shaking or agitating with a needle point. The formation of crystallites is contemporaneous with that of the globulites, the latter giving rise to the large drops, which, upon soldifying, become spherulites, and the former growing into microlites by the accretion of *invisible* particles. The crystallites do not grow by the addition of globulites. These bodies add themselves to the large drops, and never to the small, solid embryo crystals.

---

[17] Bull. d. l. Soc. Franc. d. Min., xv, p. 127.

[18] AMERICAN NATURALIST, Oct., 1892, p. 849. Ib., Apr., 1893, p. 385.

[19] Miner. Magazine, x, p. 24.

[20] Ib., x, p. 10.

[21] Bull. Soc. Franc. d. Min., xv, p. 230.

[22] Ib., p. 221.

[23] Ib., p. 231.

[24] Neues Jahrb. f. Min., etc., 1893, I, p. 89.

Miscellaneous.—A couple of *slags* from the lead ovens of Raibl, Austria, have been examined chemically by Heberdey.[26] The composition of different portions of the various specimens were carefully worked out. In one specimen crystals of a lead-zinc *olivine* were found, the analysis of which yielded:

SiO_2	PbO	ZnO	MgO	FeO	CaO	Total
16.62	61.50	18.16	1.99	1.69	tr	= 99.96

Their density is 5.214 and axial ratio $a : b = .8592 : 1$. In an appendix to his main article the author gives the results of analyses of the limestone in which the galena smelted in the furnace occurs. One of these analysis yielded: $CaCO_3 = 53.50$; $MgCO_3 = 46.51$; Fe, Tl, Li = traces.

Dunnington and Whitlock[27] communicated the results of an analysis of a *black soil* from a point in the valley of the Red River of the North, about fifteen miles south of Winnipeg, Manitoba, and Corse and Baskerville[28] the results of analyses of *glauconite* sand from near Han-

---

[25] Mitth. d. miner. Inst. d. Univ. Kiel. B 1. H. 4., p. 310.

[26] Zeits. f. Kryst., xxi, 1892, p. 56.

[27] American Chem. Journal, 14, 1892, p. 621.

[28] Ib., p. 627.

over Court House, Virginia. Analyses follow (I, black soil; II, glauconite):

	Sand	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	CO_2	P_2O_5	K_2O	Org.	H_2O
I	59.82	5.45	.64	7.14	4.00	.61	.61	.03	.37	.13	1.91	12.49	6.86

	Quartz	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O		Total
II	2.76	47.45	7.33	12.03	9.43	.57	2.90	5.75	.42	9.85	=	98.49
	8.22	43.34	6.62	15.16	8.33	.62	.95	4.15	1.84	10.32	=	99.55

Schwartz has treated in a comprehensive essay[29] the history of the observations on *reciprocal changes* produced in polymorphous bodies under different conditions of temperature, and has, in addition, given the results of some independent observations of his own. The substances that have been experimented upon are: AgI, KNO_3, NH_4, NO_3, $AgNO_3$, Rb (NO_3), boracite, perchlorethane, tetrabrommethane, and copper, nickel, zinc and cobalt, sodium-uranyl acetates.

Ch. Friedell[30] has examined carefully a specimen of the meteoric iron from Cañon Diablo, Arizona, and, as a result of his study, has concluded that particles of black diamond (carbonado) are disseminated through its mass. A combustion of the residue obtained upon treatment of the iron by acids leaves no doubt but that the material consists principally of carbon.

---

[29] Gekronte Preisschr. Univ. Goëtinger, 1892.

[30] Bull. Soc. Franc. d. Min., xv, p. 258.

BOTANY.

Kuntze's Revisio Generum Plantarum, Etc. III.—Professor MacMillan was perhaps right in saying that the present upheaval in botanical nomenclature was signalized rather than caused by the appearance of the first two parts of Dr. Kuntze's work in 1891. That is, it was the chaotic state of nomenclature which caused Dr. Kuntze to write his book, not Dr. Kuntze nor his book which caused the chaotic state of nomenclature. But while this is undoubtedly true, it cannot be denied that Dr. Kuntze's work has so thoroughly exposed the condition of things and thereby caused such extraordinary activity in nomenclature, that whatever good results from the present movement must be attributed almost wholly to the influence of his work. For, while the present upheaval, to use Professor MacMillan's apt term, was probably inevitable, and the state of nomenclature was such as to make it only a matter of time, yet Dr. Kuntze and the years of patient research culminating in his work must be recognized as the immediate cause.

But Dr. Kuntze has not been content to rest here with the movement fairly started. With admirable zeal he has followed up his first advantage, and in the third part of his work—or rather the first division of it—which appeared in August, he has shown that unlike most reformers, he can not only start a revolution but can guide it as well.

In the *Botanische Centralblatt* for June, 1893, appeared a preliminary sketch of what is set out more fully in the first sections of the third part of his work. He gave a list of all the reviews of the first two parts, and all the works dealing with nomenclature, and all propositions for reform from the appearance of his work to May 1893, together with brief criticisms of each. Now he brings together all the critiques of his book, quoting them in full, all the propositions for reform, and the material parts of all articles, etc., dealing with nomenclature, and appends a critical commentary. The critiques number about forty, and with the other articles, etc. commented upon make a list of fifty seven. It may be doubted if such a symposium has before been brought together on such a subject. Not only is it valuable of itself, but it must convince the most skeptical of the extent and significance of the movement Dr. Kuntze has set on foot.

In one respect Dr. Kuntze has a great advantage over his reviewers He has devoted more time to the subject and knows more about it in all its details than probably any man living. Consequently anyone attempting to criticize him does it at the peril of having a multitude of facts cited to him of which he had been but dimly conscious or of which he had never dreamed. Though one may not be able to agree with Dr. Kuntze as to many points, he must admit that a perusal of his commentary shows him fully able to cope with any of his adversaries and that he rarely comes out "second best." It should be added that this method of setting out the arguments of his opponents in full is in happy contrast with the far too common practice of criticizing single extracts without giving the context to show what they mean.

The Berlin propositions, particularly the notorious proposition 4, are well criticized in three languages, so that no one can mistake Dr. Kuntze's meaning. Dr. Kuntze in this and in the polyglot circulars sent to the members of the Madison Congress has shown that he is in earnest, and botanists owe him no little gratitude for the pains he is taking to secure a right termination to the movement.

In this connection his remarks on the Genoa Congress are noteworthy. He is perhaps a little too severe in his objections to the use of the Italian language by the Congress. It may be that to ask botanists to add Italian to the rather heavy list of languages they must know is too much. But the Italian botanists have certainly merited the recognition, and law or no law, if they keep on at their present gait, we shall be obliged to know something of their language. Besides we do not all have to wield foreign languages with the ease with which Dr. Kuntze handles them to be able to understand sufficiently the most of what a botanist has to say. But Dr. Kuntze's criticism on the international character of the Congress is well taken. It is folly for any Congress which is not international in composition to attempt international legislation. No laws will be observed till they are enacted by an assembly whose jurisdiction is beyond question and whose composition commands the respect of all countries.

The remaining sections discuss the orthographic license, supplementary resolutions to the Paris Code, "1753, *die Nomenclatur der Unbewussten,*" and "1737, *die Neue Compromiss in spe.*" These last two sections are devoted to the important question whether 1737 or 1753 shall be the starting point of nomenclature. 1735 which he first proposed, and which has a certain logical foundation in its favor, he now gives up for 1737 as a compromise. This is wise. The 1737 names where they differ from the names of 1735 are a great improvement on them. He gives a list of the changes necessitated in the names given in parts I and II by his new starting point. This list is a considerable one, and as the 1737 names brought in are quite often those in common use lately, it gives new strength to his position by practically removing one of the commonest objections made to it. It has been noted by several that the changes demanded by the 1735 starting point were not so frightfully numerous as they have been represented. The changes in so-called current names (for in the last ten years at least we have had no really stable current names) required by the 1737 starting point are comparatively few, and in this his compromise has an advantage. American botanists have preferred 1753, and that date has served as the basis for the nomenclature of several American publications, and gained considerable foothold. I shall not at this time discuss the relative advantages of the two dates, but shall merely observe his arguments. To change from 1753 to 1737 would require no very great number of alterations, and one may well be satisfied with either date, provided absolute fixity is attained. Of the points he makes against the 1753 starting point the strongest one is this. He charges that in the *Species Plantarum* of 1753 there are a number of *genera vitiosa* which represent an undetermined number of modern genera, while the genera of 1737 to 1748 are mostly clear. There are even, he says, monotypic genera in 1753 which under one species comprehend several modern genera. This is a charge of considerable weight and he cites several examples in support of it. The other objection, that in starting with 1753 we become entangled in the question of determination of Linnæan species, is also not without weight. Our starting point ought to be free from any entanglements which will allow botanists in time to come to overhaul accepted names under the guise of enforcing the law and question their validity.

In calling the nomenclature of 1753 the nomenclature of the ill-informed, or as he translates it "badly instructed," botanists, he is perhaps right in the sense in which he means it. It was, he says, taken up by persons who were not fully acquainted with the circumstances. But few besides Dr. Kuntze were fully acquainted with the circumstances till the appearance of his book made it in some degree possible without years of special study.

The succeeding section is a discussion of signs for growth, etc. with a suggested international code. The most remarkable thing about this code is its elaborateness. It provides signs for nearly every conceivable form of growth, and, if it gets into use, it will necessitate constant reference to the key, as it would be no small task to memorize it. While such signs are very convenient, it may be doubted whether there is any advantage in so elaborate a system.

The remainder of the book is taken up with the "*Codex Nomenclaturæ Botanicæ Emendatus*," the Paris code amended and supplemented. This is given in German, English, and French in parallel columns. Most of Dr. Kuntze's amendments are already well known from the discussion in the introduction to parts I and II. This *Codex Emendatus*, whether adopted *in toto* or not, must serve as the basis for any future emendation of the Paris Code. The "leaks" have been pointed out by Dr. Kuntze, and must be stopped—whether in his way or in some other.

A few points in his discussion of orthography may be noticed. He proposes to translate the Greek *upsilon* always by *i* instead of *y* except in a few cases where *u* stands for it, as *Cupressus*. He also proposes to eliminate the *h* in Greek words except in the combinations *ch*, *ph*, and *th*. To these and a few other propositions of the sort, I think it may fairly be said that they rest almost wholly on "*Bequemlichkeitmotiven*." It will be hard for botanists with classical training to yield to them. The tendency to revolt from such rules, if they can be adopted, will always be strong. No rule founded on convenience or on anything but *right* can be sure of enduring observance. Dr. Kuntze has taught us this thoroughly already.

But aside from such details, Dr. Kuntze deserves only thanks for what he has done. Botanical nomenclature bids fair to have in him a second father.—Roscoe Pound.

ZOOLOGY.

How Young Flickers are Fed.—An interesting account of a brood of young flickers is given by Mr. William Brewster in *The Auk*, July, 1893. During three days observation, Mr. Brewster saw only the male parent, which, however, was very attentive to his charge. Alighting on the trunk of the stump containing the nest, the flicker would utter a peculiar call, a low anxious *woi* or *wó–ă*, addressed, apparently to the young, to which they would reply with a burst of clamor, and almost immediately their wide opened mouths would appear at the top of the burrow. Standing on the edge of the hole, the parent selected one, and bending forward and down drove his bill to its base into the gaping mouth which insantly closed tightly round it, when the head and bill of the parent were worked up and down with great rapidity for from one to one and a half seconds, the young meanwhile never losing its grasp. These up and down motions were rapid, regular, and not unlike those of a wood-pecker engaged in drumming. They also suggested the strokes of a piston. If interrupted during the pumping process, the flicker would often feed the same young twice or even thrice in succession, but this never happened when the first period of contact was of normal length.

Four young were generally fed at each visit, with a brief interval of rest between the operations. During this interval the parent would open and shut his bill, run out his tongue, and work the upper portion of his throat as if tasting and swallowing something. The inference was that this was for the purpose of regaining the particles of food which had failed to lodge in the throat of the young.

The time spent at the nest rarely exceeded half a minute, while the foraging expeditions occupied from twenty minutes to an hour. The flicker's return was so stealthy that the writer, although on the watch, frequently did not see him until he appeared at the nest. His bill was always closed up to the moment of contact and there was no evidence that he carried food in his mouth. In fact, it was clear that he *swallowed* all the food obtained and afterward supplied it to the young by a process of *regurgitation.* Of what the food consisted, the writer was unable to discover without killing one of the young, to which mode of settling the point he was extremely averse.

Forsyth Major and Rose on the Theory of Dental Evolution.—In the NATURALIST for June, 1893, Professor H. F. Osborn has stated the manner in which Kükenthal and Röse defend the theory that the complex dental crowns of the later Mammalia, are the result of the fusion of a number of primitive, distinct, simple reptilian teeth. Professor Osborn and myself have shown that the history of mammal dentition indicates the opposite process to have taken place; viz, the gradual accession of cusps to a simple primitive cusp, by a process of complication. The well known fact that the dental cusps become more numerous and display greater modifications with the passage of geological time, is opposed to the idea supported by the authors cited.

Dr. Röse has recently endeavored to explain[1] the origin of the dentition of the elephant. As is well known, the transverse crests are laminiform, and reach the number of twenty-three in the *Elephas indicus*. It is also well known that as we pass backward in time we find in the earliest known proboscidians, posterior molar teeth with only four, and even two transverse crests. This fact is one of many which distinctly negatives the fusion theory. Dr. Röse's explanation is truly extraordinary. He declares the complexity of the molar of *Elephas* to be due to a reversionary inheritance of a reptilian dentition, and fusion of the dental elements of the same. Thus the farther removed from the ancestral Reptilia we get, in time and in character, the stronger becomes the hereditary tendency! This seems to be the *reductio ad absurdum* of the theory.

Dr. Forsyth Major makes an interesting contribution to the subject in a paper in the Proceedings of the London Zoological Society,[2] on the dentition of the Sciuridæ. He announces his disbelief in the trituberculir origin of the placental mammalian dentition, and supports the view that all the forms, including the tritubercular, are the descendents of a multitubercular type, as now found in the Multituberculata. He believes that the superior molars of the squirrels support his contention, as he thinks that he can trace them better from a multitubercular than from a tritubercular origin.

I have stated as is my belief, as long ago as 1883,[3] that the Glires were descended from the Tillodonta, and no reason has since appeared to invalidate this opinion. It was strikingly confirmed by the discovery that there were no Glires in the Puerco fauna, while Tillodonta are not rare. In the Tillodont dentition we have all the materials necessary for the evolution of the glirine dentition along the usual lines. Dr. Forsyth Major appears to have overlooked this aspect of the case, and it will be necessary to dispose of this theory before progress in any other direction can be made.—E. D. Cope.

---

[1] Morphologischen Arbeiten von Schwalbe, Strassburg i. E., 1893, p. 173.

[2] Proceeds. Zoolog. Sci. London, 1893, p. 179.

[3] Extinct Rodentia of North America, AMERICAN NATURALIST, p. 380; Op. cit. 1885, p. 347 more definitely.

Effects of Temperature on the Coloring of Lepidoptera. —In Insect Life, Vol. III, p. 481, is given the following resumé of a series of temperature experiments conducted by Mr. Merrifield in pedigree moth-breeding, begun in previous years, on the pupa of *Selenia illustraria* and *Ennomos autumnaria.*

By careful and long continued experiments Mr. Merrifield has demonstrated the possibility of producing artificially from a single brood of a moth, subject to seasonal dimorphism, four distinct "temperature" varieties, viz.: summer markings with summer coloring, summer markings with an approach to spring coloring, spring markings with summer coloring, and spring markings with spring coloring. The conclusions reached as a result of this series of experiments are that the coloring and markings of the moth are affected by the temperature to which the pupa is exposed, the marking being chiefly produced by long continued exposure; that the coloring is affected chiefly during the stage before the coloring of the perfect insect begins to show; that a low temperature during this stage causes darkening, a high temperature producing the opposite effect, a difference between 80° and 57° being sufficient to produce the extreme variation in darkness caused by temperature; a further lowering of temperature having no further effect; that nearly the full effect in coloring may be produced by a range of temperature of from 76° or 80° to 65° in *autumnaria,* and from 73° to 60° in *illustraria;* that dryness or moisture during the entire pupal period has no appreciable effect on the coloring of the adult.

A general conclusion which the author ventures to suggest—provided we accept the theory of Professor Weismann, that existing forms of North American and European Lepidoptera have come down from a glacial period—is, that "icing" the pupa causes the insect to revert to its earlier form, and that experiments of the nature here recorded might be of material assistance in tracing the evolution of the markings on the wings of the most highly developed forms.

In a supplementary note Mr. Merrifield adds that it is possible to cause either the summer or winter form to take on the coloring of the other, and produce from moths from the summer pupa, specimens that resemble those from the winter pupa, but not *vice versa.*

The details of these experiments can be found in Part I, Trans. Ent. Soc., London, 1891, pp. 155–167.

Fish Acclimatization on the Pacific Coast.—The attention of fish culturists is called to the remarkable results of the experimental introduction of food fishes to the west coast of the United States. In 1871, the California Fish Commission deposited 12,000 young shad in the Sacramento River, and after that the United States Fish Commission carried on the work until 1886, during which time 609,000 young shad were placed in the Sacramento River, 600,000 in the Williamette, 300,000 in the Columbia, and 10,000 in the Snake River. Two or three years later a few mature examples were obtained in the Sacramento River, and, by degrees, marketable fish were obtained along the entire coast of the United States north of Monterey Bay. In 1887, they were abundant in some rivers, common in most of them, and occasional ones were found everywhere along this long coast line. In 1892, the catch was estimated at 660,000 pounds. A careful estimate places the total value of the shad catch on the Pacific coast to date at $145,000, representing over 3,000,000 pounds, while the aggregate outlay for all purposes connected with the introduction of the fry was less than $4,000.

The history of the striped bass, *Roccus lineatus*, is similar to that of the shad. In 1879, about 150 fish a few inches long were deposited at the mouth of the Sacramento River by an agent of the U. S. Fish Commission coöperating with the California Commission. In 1882, another plant of 300 fish was made in the same region. As a result of these two small plants, the species soon became distributed along the entire coast of California. The rapid growth of individuals, and the equally rapid distribution of the species indicate the special adaptability of the waters of the region to this fish.

In commercial importance the striped bass ranks high. Large quantities are taken for market in San Francisco Bay with seines and gill nets. The average weight is eight to ten pounds, but fish weighing forty pounds are not scarce. The aggregate yield to date is nearly 100,000 pounds with a value of $18,000. The cost of introduction was not more than a few hundred dollars. In both of these cases cited the investment of the people's money has proved most satisfactory. (Science, Aug., 1893).

ENTOMOLOGY.[1]

The Androchonia of Lepidoptera.—In general all the scales of Lepidoptera are modified hairs and originate as papillæ-like protuberances on the surface of the wing. In structure they are at first double walled closed sacs, but soon flatten out and striæ appear; in greatest numbers on the outer surface. The arrangement on the wing may be regular or irregular. The coloring is a matter of some interest and may be due to the refraction of light on the finely ruled surface, or a pigment located between the two walls of the sac and away from direct contact with the air. But it is not the object of this paper to discuss the ordinary scales of Lepidoptera.

More than 50 years ago Bernan Deschamps observed other scales on the butterflies and from their shape called them plumules. The name was not a good one however, and has since fallen into disuse. The name androchonia was substituted and it is now the one by which the so-called scent-scales or hairs of the *male* Lepidoptera are known.

The androchonia are found in the same way as the ordinary scales, from papillæ which rise on the surface of the wing. As regards their occurrence they may be massed together in patches or scattered irregularly over the surface. If in groups they are always concealed by the large imbricated scales that seem to be congregated at that point to protect them. Often, however, they are protected by being located in a pocket or fold of some portion of the wing, as for example, in one tribe the Hesperidi, they are located underneath the reflexed margin of the fore-wings. This is their location in *Eudamus tityrus* where the marginal vein is folded back until it no longer forms the outermost edge of the wing.

In the common milk-weed butterfly (*Danais archippus*) they are located at the dark spot on the second pair of wings near the first venule of the median vein. In this case they are protected by a proliferation of the membrane of the wing which forms for them a pocket. On the second pair of wings in *Thecla calamus* they are simply collected in one region on the surface and protected by large scales which are very prominent at that point. When scattered irregularly over the wing they are always underneath the large scales and therefore well shielded.

The androchonia are very much smaller than the ordinary scales and can easily be identified. Some are black or brown but usually they are devoid of color. The color given to the patches where they occur is usually due to the coloring of the large scales that are for their protection. The androchonia vary much in form, many of them being simply hair-like, others feather shaped or rod-like with a plumed tip. In structure they are much softer than the ordinary scales and consequently much more pliable, which later property serves a very efficient purpose in their concealment. There is often a canal extending from the base to the tip of the scale where it may find a direct outlet or disappear in the spongy mass found at the end of a large variety of these androchonia.

---

[1] Edited by Clarence M. Weed, Durham, N. H.

At the base of many are found the true ball and socket joints like that in the ordinary scales.

It has been shown by Weisman that the wings of the Lepidoptera do contain living tissue and this would allow the production of odors through local scent glands. This arrangement has often been conjectured but it seems that either no attempts have been made at a systematic study of the subject or the attempts have ended in failure. The trouble was no doubt due to a lack of care in the preparation of the material for study. It was found after repeated attempts that the best results were obtained by hardening the freshly removed wing in alcohol, infiltrating with collodion and preparing serial sections by the use of a microtome.

The results of careful study and repeated observations on many series of sections of various Lepidoptera has shown the androchonia to be the outlet of certain glands located in the tissue of the wing beneath the androchonia bearing surfaces. The glands in sections were very prominent and no doubt of their genuineness could be entertained. One especially prominent was found beneath the androchonia in the wing of *Danais archippus*. The character of the surface of the wing above the glands is often very interesting, it sometimes being covered with a great number of papillæ from the end of which the scent scales project; or it may be like the ordinary surface of the wing. In the former case the androchonia are quite small and but one to each papilla, at the base of which we find the gland. This gives the scent scale the appearance of a small rod placed in a flask. In the tissue of the wing we find numerous canals ramifying in various directions. The material elaborated by the local glands and distributed upon the surface of the wing by the androchonia is that which gives to many of the Lepidoptera their characteristic odor.

Müller has been able to recognize more than 30 distinct odors in different patches of these scent scales. The use of the odor is no doubt in many cases for protection, but it must also assist in sexual selection.

This study was undertaken at the suggestion of Professor J. H. Comstock, to whom I am indebted for the material examined.

M. B. Thomas,
Wabash College.

Description of Plates.

Fig. 1.—Transection of wing of *Danais archippus* showing the location and arrangement of the androchonia.
" 1*a*.—First venule of the median vein.
" 1*b*.—Androchonia bearing surface.
" 1*c*.—Glands below the surface and in the tissue of the wing.
" 1*d*.—The proliferation of the wing for protecting the surface.
Fig. 2.—Hind wing of male *Danais archippus*.
" 2*a*.—Location of androchonia (nat. size).
Fig. 3.—Transection through the marginal vein of the fore-wing of *Eudamus tityrus* showing location of androchonia in the pocket formed by folding over the marginal vein.
" 3*a*.—Marginal vein.
" 3*b and c*.—Other veins.
" 3*d*.—Location of androchonia.
" 3*e*.—Large scales on the wing that protect the androchonia.
" 3*f*.—Edge of the wing.
Fig. 4.—Transection of the hind wing of *Thecla calamus* at the place where the androchonia are congregated.
Fig. 5.—View of surface of the wing of *Thecla calamus* giving the arrangement and abundance of the scent scales as compared with the ordinary one. (6) Androchonia.
" 5*a*.—Ordinary scales.
Fig. 6.—Trans. of wing androchonia surface on the wing of *Thecla calamus*.
" 6*a*.—Androchonia.
" 6*b*.—Glands at the base.
" 6*c*.—Ordinary scales.
" 6*d*.—Wing in section.
Fig. 7.—Trans. of wing of *Thecla calamus*, showing the androchonia with large gland at base.
" 7*a*.—Androchonia.
" 7*b*.—Surface of wing.
" 7*c*.—Tissue of wing.
Fig. 8.—Gland.
Fig. 9.—Androchonia.
Figs. 10 and 11.—Androchonia in trans-and longisection.

Figs. 12–21.—Various kinds of androchonia and scales, showing relative sizes.

BIBLIOGRAPHY.

Anthony, J.	The Markings on the Battledore Scales of some of the Lepidoptera. 8o., London, 1872.
McIntire, S. J.	Notes on the Minute Structure of the Scales of certain Insects. 8o., London, 1871.
Müller, F.	A prega costal das Hesperideas. 4o., Rio, 1878.
Scudder, H. S.	Antigeny or sexual dimorphism in Butterflies. 8o., Boston, 1877.
	Butterflies of Eastern U. S. and Canada.
Waufor, T. W.	On certain Butterfly scales characteristic of Sex. Oo., London, 1867, 1868.

Fleshy Cecidomyiid Twig Gall on Atriplex canescens.—Numerous fleshy tumor-like twig gall, were found on *Atriplex canescens*, May 13, 1892, on mesa back of college grounds, near Las Cruces, New Mexico. One gall that was opened disclosed two cecidomyiid pupæ in separate cells within. This gall, with its occupants, was placed in alcohol. Other galls were pinned and allowed to dry. The latter, on being opened nearly a year later, disclosed a cecidomyiid larva, several cast pupal skins, and in one cell a transformed hymenopterous parasite. From the alcohol gall the following description is drawn.

Gall.—Length, 12 mm.; width, 4½ to 6½ mm. Rather oblong, more or less irregular in shape, fleshy when green, tumor-like, formed on one side of twig, which is itself involved in the gall. Pale greenish in color, sometimes more or less reddish as noticed in the dried galls. Outer skin of gall smooth. Two cavities inside, each about 2 by 3 mm. in diameter.

One specimen. This cecid may be called *Cecidomyia atriplicis.*

The dried galls show the twig plainly, not involved in the gall. They are red to greenish in color, surface naturally wrinkled and somewhat roughened, with sections of the thin bark of the twig showing upon the surface, but I am inclined to consider them the same as the above. This opinion is induced by the similar character of the occupants. The cells also are similar in size and shape, several in each gall according to size of latter. Some of the smaller dried galls are more rounded in shape.—C. H. TYLER TOWNSEND.

Trichodactylus xylocopæ in California.—Some little time ago I received from Mr. D. W. Coquillett, Los Angeles, California, an interesting parasite of *Xylocopa,* and which proved on examination to be *Trichodactylus xylocopæ.*

As I know of no previous record of this Acarid, or any in this genus, being recognized in America, it seems worth while to mention it in the *Naturalist.* The specimens were taken from a Carpenter Bee and mounted in balsam by Mr. B. W. Griffith. The bee Mr. Coquillett says agrees with specimens named for him by Prof. Riley as *Hylocopa æneipennis.*

Doubtless this parasite could be found on *Xylocopa* in other localities and related species on *Osmia* and other related bees.

HERBERT OSBORN.

ARCHEOLOGY AND ETHNOLOGY.

Explorations in the Delaware Valley.—Mr. H. C. Mercer has made the following report to the department of Archeology and Paleontology of the University of Pennsylvania, on the progress of field work.

The study of the ancient argillite quarries at Gaddis' Run, Bucks County, Pa., discovered May 22, 1893, and bearing directly on the problem of the antiquity of Man in Eastern North America, is of great importance, because

(*a*) These quarries, unlike the jasper mines in the Delaware Valley, recently proved to be the work of modern Indians, are workings by some ancient people in *argillite* (metamorphosed slate with conchoidal fracture), the same stone with which numerous observers assert that Man living on the lower Delaware, at the time of the melting of the great glacier, made his rude implements; because

(*b*) Granting that glacial man, obtaining his material either at this first outcrop of the rock on the right river bank above his habitat, or from erratic ice-born masses in the river bed, chipped argillite implements at Trenton 7 to 10,000 years ago, we may here learn whether the quarries were the work of the modern Indian, or of an older race —of a stone chipper ignorant of stone polishing, (Paleolithic Man), or of a stone chipper who could also polish stone, (Neolithic Man), and because

(*c*) The quarries, if the work of the Neolithic Indian, may show us to what extent the use of argillite was continued into recent times, and whether, as at the jasper quarries of Durham, Vera Cruz, Macungie and Saucon Creek, the chipped refuse is scattered with " wasters " or blocked out blades resembling in form the supposed more ancient specimens found in the glacial gravel at Trenton.

The sum of $19.25 of the $25 subscribed for exploration by the Board since the last meeting of the American Committee, has thus far resulted in the ascertaining by shafts of the extent of the quarried area, the mapping of the 19 ancient pits and 12 workshops, the study of the quality and fracture of the native stone, the cleaning out of one of the pits and trenching of 2 refuse heaps by shaft A, 21 feet by 15 feet 7 inches by 7 feet deep, and shaft G, 28 feet by 7 feet 6 inches by 3 feet 9 inches deep, discovering 279 chipped leaf-shaped forms and

145 hammer stones, 4 fire sites, and 6 large blocks pecked upon their sides to split with the grain.

The method of quarrying, probably without digging implements, and of fracturing the loose masses without fire, has been studied, while many conditions bearing on the relation of the place to the neighboring river beaches, other possible quarries and the Indian village site at Lower Black's Eddy remain to be examined.

As yet no positive relic of the modern Indian (unless we except 3 hammer stones with pecked sides) has been found, though nothing suggests the labor of a race more ancient, nor intimates that the chipped forms, which have not yet been compared with the Trenton specimens, were finished implements.

The International Congress of Pre-Historic Archeology and Anthropology held its Eleventh session at Moscow Russia, August, 22–30, 1892.

The papers read were as follows:

GEOLOGY AND PALEONTOLOGY IN THEIR RELATION TO PRIMITIVE MAN.—On the composition of the quaternary deposits of Russia and their relation to the works resulting from the activity of prehistoric man, *S. Nikitine.*——A review of the post tertiary deposits in connection with the finding of traces of prehistoric culture in the north and east of European Russia, *Th. Tschernyshev.*——Remarks on the caverns of Oural, *O. Clerc.*——On the remains of a paleolithic epoch in the neighborhood of Krasnoïarsk gouv. de Ienisséisk, Siberia. *J. Savenkov.*——The Russian steppes, ancient and modern, *W. Dokontchaïev.*——On the remains of *Ursus spelœus* and of a fossil *Ovibos* found in Russia, *D. Anoutchine.*

PREHISTORIC ARCHEOLOGY (except Kourganes and Goroditchtschés).——A comparison of the primitive industries of France and Asia, *G. Chauvet.*——The latest conclusions concerning prehistoric archeology in Bohemia and its relations with eastern Europe, *Lŭbor Niederle.*——A study of the barbarian sculptures belonging to the Visigoth epoch in middle France, *C. Barriere—Flavy.*——On nephrite, *Count Cassini.*——On the questionable objects of nephrite found in the Oural *O. Clerc.*——Marks of gnawings on paleolithic and neolithic bones, *Prince Poutjatine.*——The paleolithic epoch in the neighborhood of Novgorod, *B. Pèrèdolsky.*

KOURGANES AND GORODITCHTSCHES.—Goroditchtschés of bones in northern Russia, *A. Spitzine.*——Deposits of stone implements in the district of Jarausk, gouv. de Viatka, *P. Krotov.*——The "Jalnik" of

Iuriévo, in the district of Borowitchi, gouv. de Novgorod, *B. Pèrèdolsky.*——On the shield cups of the ancient Scythians, *N. Brandebourg.*

ANTHROPOLOGY.—The question of race in Anthropology, *M. Topinard.*——Brain weights of individuals of various Causcasian tribes, *N. Guiltchenko.*——European races and the Aryan question, *Kollman.* ——Notes on some skulls, artificially deformed, found in Russia, *D. Anoutchine.*

PREHISTORIC ETHNOGRAPHY.—Contributions to the prehistoric ethnography of central and northeastern Russia, *J. Smirnov.*——Vestiges of Paganism in the region between the headwaters of the Oka and the Don, *N. Troïtzky.*——Notes on the questions;—1. Of the co-existing customs of sepulture and incineration. 2. Of certain stone statues called " Kamennya baby, " *A. Ivanovsky.*——What is the oldest race in Russia? *A. Bogdanov.*

MICROSCOPY.[1]

Methods of Preparing Molluscan Ova.[2]—The results of my work for the first three months were not promising and it was not until I had hit upon my present methods of preparing surface views of the entire ova that any detailed study of the cleavage could be made. Since I owe most of my results to this method and since I am convinced that it may be profitably employed in the preparation of the surface views of many different objects I believe it merits a detailed description.

The ova were fixed in many different fluids—Kleinenberg's Picro-sulphuric, Picric acid in sea water, Merkel's, Perenyi's, Flemming, stronger and weaker, Auerbach's, Corrosive sublimate, Chromo-formic, Chromo-acetic and absolute alcohol—but none of these methods for a moment compare with the first named, i. e. Kleinenberg's stronger picro-sulphuric. The ova were left in this for a length of time varying from fifteen minutes to one hour and were then gradually transferred to 70% alcohol. They were left in this until all traces of picric acid had been washed out and were finally preserved in 95% alcohol. During the first year of the work many of the preparations were ruined by becoming very dark, owing I think to the extraction of tannin from the corks. This trouble was afterward avoided by using rubber corks, or better still by coating ordinary corks with a thin layer of paraffin.

As a result of many experiments with almost every one of the common staining fluids, I found that the best method of preparing surface views of the whole egg or embryo was the following:—(1) Transfer the object gradually from alcohol to water. (2) Stain from five to ten minutes in a solution of Delafield's (Grenacher's) Hæmatoxylin diluted about six times with distilled water and rendered *slightly* acid by a trace of HCl. (3) Dehydrate and clear in oil of cedar or cloves. (4) Mount in Balsam supporting the cover glass so as to prevent crushing. By occasionally softening the balsam with a drop or two of xylol and slightly moving the cover glass the objects can be rolled into any position desired.

By this method wonderfully beautiful surface preparations were obtained showing with remarkable clearness not only the nuclei and cell boundaries but also the caryokinetic figures and in many cases the archoplasmic spheres and centrosomes. One very considerable advantage of this method is that the preparations were permanent—in fact they become better with age instead of degenerating. All the preparations from which the figures were drawn are still in existence and can be consulted at any time.

---

[1] Edited by C. O. Whitman, Chicago University.

([2] Extracted from a paper to be published later on the development.)

I have employed this method with almost as good results in the preparation of surface views of the embryo chick and English sparrow and also with considerable success on other molluscan eggs and embryos as well as those of annelids and echinoderms.

—E. G. Conklin, Delaware, Ohio.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Congress Auxiliary of the World's Columbian Exposition of 1893. THE PHILOSOPHICAL CONGRESS.—August 21st.—R. N. Foster, Chairman, Henry M. Lyman, Vice-Chairman, L. P. Mercer, A. N. Waterman, Paul Carus, Louis J. Block, H. W. Thomas, Melville E. Stone, Committee on the World's Congress Auxiliary on Philosophy.

Addresses of welcome by the President of the World's Congress Auxiliary and others. Responses in behalf of different Congresses and Countries. Upon the conclusion of these opening ceremonies the Congresses of the several general divisions of the Department assembled in the halls assigned to them and proceeded as designated in their respective programmes.

Address of welcome. Hon. Charles C. Bonney, President World's Congresses. Address introducing philosophy to the audience. R. N. Foster, Chairman of the Committee of Organization.

August 22nd, Kant's Fallacy Respecting the Principle of Causation, W. T. Harris, LL. D., United States Commissioner of Education, Washington, D. C. Teleology in the Modern Philosophy of Nature, Professor H. N. Gardner, Smith College, Northampton, Mass. Present Prospects of Philosophy in Europe, Professor W. Luteslawski, University of Kazan, Oriental Russia. Faith as a Faculty of the Mind, What it Reveals and What it Commands, Professor Thomas Davidson, Keene, Essex County, N. Y. Inquiries into Relations between form of Hand and Character, Francis Galton, F. R. S. London, England. Gioberti and the Synthetic Principle of Philosophy, Brother Azarias de La Salle Institute, Brothers of the Christian Schools, New York City. The Two-Fold Nature of Knowledge, Imitative and Reflective, Professor Josiah Royce, Ph. D., Harvard University, Cambridge, Mass. On the Reconciliation of Science and Philosophy, Professor John Dewey, Michigan University. The Debt of the Moderns to Plato, Thomas M. Johnson, A. M., Osceola, Mo. Ethics of Hegel, Professor J. Macbride Sterrett, Columbian University, Washington, D. C. The Æsthetic Consciousness, Professor J. Steinforth Kedney, M. A., Faribault, Minn. The Underlying Principles of Thomistic Philosophy, Brother Chrysostom, Professor of Mental Philosophy in Manhattan College, New York City. Philosophy and Industrial Life, Professor J. Clark Murray, LL. D., McGill College, Montreal, Canada. A New

Non-tentative and Economic Method of Solving Equations, President J. W. Nicholson, A. M., Louisiana State University, Baton Rouge. Significance of the Realistic Movement in Art and Literature, L. J. Block, LL. D., Chicago. Ethical Aspects of Pessimism, Miss Louise Hannum, Ph. D., Ithaca, N. Y. Insufficiency of the So-called Cosmic Philosophy, Professor Geo. H. Howison, University of California, Berkeley, Cal. Is there a Science of Psychology? Professor Paul Shorey, Ph. D., Chicago University. The Illuminati, Mrs. Mary H. Wilmarth, Chicago. Idea and Purpose of Plato's Republic, Professor H. K. Jones, Jacksonville, Ill. The Duty of Philosophy, Paul Carus, Ph. D., Chicago. Common Sense, Science and Philosophy, Professor B. C. Burt, M. A., Ann Arbor, Mich. The Notion of Duty in Modern Ethics, President J. G. Schurman, Cornell University, Ithaca, N. Y. Philosophy of Education, Professor J. E. Bushnell, Kee Mar College, Hagerstown, Md.

The Congress on Psychical Science.—August 2st.—Ellicott Coues, M. D., Chairman. Richard Hodgson, LL. D., Vice-Chairman. Ernest E. Crepin, Lyman J. Gage, D. Harry Hammer, D. H. Lamberson, J. H. McVicker, Hirman W. Thomas, D. D., B. F. Underwood, General Committee on a Psychical Science Congress.

Addresses of welcome, by the President of the World's Congress Auxiliary and others. Responses in behalf of different Congresses and countries. Opening Address by the Chairman, Professor Elliott Coues. Human Testimony in Relation to Psychical Phenomena, Richard Hodgson, LL. D. A Brief Critical History of the Spiritualistic Movement in America since 1848, Giles B. Stebbins. Spiritualistic Interpretation of Psychical Phenomena, Rev. Minot J. Savage. A Description of Psychical Phenomena in Brazil, Professor A. Alexander. Elementary Hints on Experimental Hypnotism, Walter Leaf, Litt. D. Contributions to the Bibliography of Periodical Literature Relating to Psychical Science, Spiritualism, etc., Benj. B. Kingsbury. Personal Investigations in Psychical Science, M. C. O'Byrne.

August 22d.—Outline of a Project for a General Union for Experimentation in Psychical Phenomena, Dr. Xavier Dariex. Experimental Thought-Transference, Frank Podmore, M. A. The Question of Phantasmal Apparitions, L. Deinhard. Programme for Experimental Occultism, Baron Carl Du Prel. Psychism amongst the Ancient Egyptians, Rev. W. C. Winslow. Psychic Facts and Theories Underlying the Religions of Greece and Rome, Dr. Alexander Wilder. Veridical Hallucinations as a Part of the Evidence for Telepathy, Professor and Mrs. Sigwick. Some Experiments in Thought-Transference and Their Significance, Dr. A. S. Wiltse. Critical Historical Review of the Theosophical Society, Wm. Emmette Coleman. Madame Blavatsky and M. Solovyoff, Walter Leaf, Litt. D. Certain Experiments with the Sphygmograph, John E. Purdon, M. D. Scientific Evidence of the Theory of Reincarnation, Capitano Ernesto Volpi.

August 23d.—The Relation of Consciousness to Its Physical Basis, Professor E. D. Cope. The Subliminal Self, F. W. H. Myers, M. A. Report on the Case of Miss Mollie Fancher, Judge A. H. Dailey. Thought and Its Vibration, Mrs. Hester M. Poole. Experiments with the so-called Divining Rod, Professor W. T. Barrett, F. R. S. E. Dreams, Considered from the Standpoint of Psychical Science, Edmund Montgomery, M. D. On Automatic Writing (so-called), Mrs. Sara A. Underwood. Experimental Crystal Gazing, Mrs. Janet E. Runtz-Rees. On the Alleged Movement of Objects without Mechanical Contact, Professor and Mrs. Elliott Coues. The Religious Significance of Psychical Revelations, Mrs. Elizabeth Lowe Watson.

August 24.—Theories Regarding Automatic Writing, B. F. Underwood. Memory in Relation to Psychical Experiences, Charles Whedon. On the Difficulty of Making Crucial Experiments as to the Source of the Extra of Unusual Intelligence Manifested in Trance-Speech, Automatic Writing and other States of Apparent Mental Inactivity, Professor Oliver J. Lodge, F. R. S. Hypnotic Suggestion, C. G. Davis, M. D. Evidence Favoring the Theory of the Dual Nature of the Human Mind, T. J. Hudson. The Etiological Significance of Heterogeneous Personality, Dr. Smith Baker.

August 25th.—Official Report of the Milan Committee on Experiments with Eusapia Paladino. Translated from the French, with M. Aksakof's Manuscript Additions and Corrections, Professor Elliott Coues. Remarks on Professor Charles Richet's "Notes on the Milan Experiments," Pofessor Elliot Coues. Further Remarks on the Milan Experiments, Dr. George Finzi. Possibilities of a Future Life, Miss Lilian Whiting. Short Account of Some of the Most Remarkable Psychical Phenomena I have Observed, Señor Alfonso Herrera. Notes of Personal Experiences, Madame E. Van Calcar. Exhibition of "Spirit-Photographs" Known to be Spurious, and of Others Which have been Supposed to be Genuine, with Remarks, Professor Elliott Coues. The Evidence for Man's Survival of Death, F. W. H. Myers, M. A. Papers written by absent authors were read by proxy.

Congress on Geology.—August 21–26.—General Committee of the World's Congress Auxiliary on a Geological Congress: Josua Lindahl, Chairman; W. R. Head, E. Andrews, Victor C. Alderson, Oliver Marcy, T. C. Chamberlin, Chas. W. Rolfe, J. P. Iddings, R. D. Salisbury. Committee of Geological Section of American Association for the Advancement of Science: T. C. Chamberlin, Chairman, H. S. Williams, G. K. Gilbert, R. D. Salisbury, J. C. Branner, J. F. Whiteaves, C. D. Walcott, N. H. Winchell, E. A. Smith, W J McGee, G. H. Williams.

Addresses of Welcome by the President of the World's Congress Auxiliary and others. Responses in behalf of different Congresses and countries. Methods of Teaching Geology, Miss Mary Holmes, Ph. D., Rockford, Ill. Physical Geology, Miss Mary K. Andrews, Belfast, Ireland. Chemical Geology, Miss Louise Foster, Boston, Mass.

August 22.—Granites of Massachusetts and Their Origin, Mrs. Ella F. Boyd, Hyde Park, Mass. Artistic Geology, Mrs. S. Maxon-Cobb, Boulder, Colo.

August 23.—The Geology of Ogle County, Mrs. C. M. Winston, Chicago. The Fossils of the Upper Silurian, Mrs. Ada D. Davidson, Oberlin, Ohio.

August 24.—Crinoidea and Blastoidea of the Kinderhook Group as Found in the Quarries near Marshalltown, Iowa, Jennie McGowen, A. M., M. D., Davenport, Iowa. The Evolution of the Brachiopoda, Miss Agnes Crane, Brighton, England.

August 25.—The Mastodon in Northern Ohio; Post Glacial or Pre-Glacial, Miss Ellen Smith, Painesville, Ohio. Paleontology, Miss Jane Donald Carlisle, England.

August 26.—Glacial Markings, Miss Thomson, Newcastle England.

August 24.—Address of Welcome by the President of the Auxiliary, Hon. Charles C. Bonney. The General Geology of Brazil, Dr. O. A. Derby, Director of the Geological Survey of Sao Paulo. The General Geology of Venezuela, Dr. Adolph Ernst, Special Delegate from Venezuela to the Columbian Exposition. Pre-Cambrian Rocks of Wales, Dr. Henry Hicks, London, England. The Classification of the Rock Formations of Canada, with Special Reference to the Paleozoic Era, Henry M. Ami, Geological Survey of Canada. The Cordilleran Mesozoic Revolution, Dr. A. C. Lawson, University of California. The Pre-Paleozoic Floor in the Northwestern States, Professor C. W. Hall, University of Minnesota. Distribution of Pre-Cambrian Volcanic Rocks along the Eastern Border of the United States and Canada, Professor George H. Williams, Johns Hopkins University.

August 25.—Huronian versus Algonkian, Dr. A. R. C. Selwyn, Geological Survey of Canada. On the Migration of Material during the Metamorphism of Rock Masses, Alfred Harker, St. John's College, Cambridge, England. Wave-like Progress of an Epeirogenic Uplift, Warren Upham, Geological Survey of Minnesota. Eruptive Phenomena of Brazil, Dr. O. A. Derby, Geological Survey of Sao Paulo. Genetic Classification of Geology, W J McGee, Bureau of Ethnology. Precious Stones and Their Geological Occurrence, Dr. George F. Kunz. The Extent and Lapse of Time Represented by Unconformities, Professor C. R. Van Hise, U. S. Geological Survey. The Phylogeny of Plants, Professor Lester F. Ward, U. S. Geological Survey. The Phylogeny of the Classes of Vertebrates, Dr. O. Jækel, Berlin, Germany. Restoration of Clidastes (illustrated), Professor S. W. Williston, University of Kansas.

August 26.—Glacial Succession in the British Isles and Northern Europe, Dr. James Geikie, Geological Survey of Scotland. Glacial Succession in Sweden, Hjalmar Lundbohm, Geological Survey of Sweden. The Succession of the Glacial Deposits of Canada, Dr. Robert Bell, Canadian Geological Survey. Glacial Succession in the United States, Dr. T. C. Chamberlin, University of Chicago. Pleistocene Climatic Changes, Warren Upham, Geological Survey of Minnesota. Evidences of the Diversity of the Older Drift in Northwestern Illinois, Frank Leverett, U. S. Geological Survey.

THE CONGRESS ON ZOOLOGY.—August 28.—Stephen A. Forbes, Chairman, Oliver S. Westcott, Vice-Chairman, Edward A. Birge, Secretary, George W. Peckham, William A. Locy, Edward G. Howe, B. F. Quimby, Committee of the World's Congress Auxiliary on a Congress on Zoology. The History and Evolution of American Zoology and the Status and Tendencies of Zoological Science in America, Dr. G. Brown Goode, Director U. S. National Museum, Washington, D. C. The Geographical Distribution of American Animals, Mr. J. A. Allen, Curator of Departments of Mammalogy and Ornithology, American Museum of Natural History, New York. The Effect of Glaciation and of the Glacial Period on the Present Fauna of America, Mr. Samuel H. Scudder, Cambridge, Mass. Preliminary Account of the Formicidæ of the North American Fauna, Professor C. Emery, University of Bologna, Bologna, Italy.

August 29.—Lacustrine Zoology: Methods and General Results of Its Investigation, Professor Dr. F. A. Forel, University of Lausanne, Morges, Switzerland. The Plankton of the Muskoka Lakes, Ontario, Professor R. Ramsay Wright, Professor of Biology, University of Toronto, Canada. The Origin of the Subterranean Animals of America, Professor A. S. Packard, Professor of Zoölogy and Geology, Brown University, Providence, R. I. The Ichthyology of the World's Columbian Exposition, Dr. Tarleton H. Bean, U. S. Fish Commission, Washington, D. C.

August 30.—The Zoological Museum, Mr. F. W. True, Curator of Mammals, U. S. National Museum, Washington, D. C. The History and Special Features of the Economic Entomology of the United States, Professor J. H. Comstock, Professor of Entomology and General Invertebrate Zoology, Cornell University, Ithaca, N. Y. The Special Problems of American Economic Entomology, Dr. C. V. Riley, Chief of the Division of Entomology, U. S. Department of Agriculture, Washington, D. C. The Ornithology of the World's Columbian Exposition, Dr. Frank N. Chapman, American Museum, Central Park, New York City. The Entomology of the World's Columbian Exposition, Professor H. E. Summers, University of Illinois, Champaign, Ill.

August 31.—Undergraduate Courses and Post-graduate Methods in Zoology, Professor E. L. Mark, Hersey Professor of Anatomy, Harvard University, Cambridge, Mass. Kinetogenesis, or the Relation of Motion to Organic Evolution, Professor E. D. Cope, Professor of Mineralogy and Geology, University of Pennsylvania, Philadelphia, Pa. Energy in Relation to Organic Evolution, Professor J. A. Ryder, Professor of Comparative Embryology, University of Pennsylvania, Philadelphia, Pa. Observations on the Loss of Weight in the Tadpoles of Amphibia Anura during the Period of Metamorphosis, Professor Lorenzo Camerano, R. Museo d'Anatomia Comparata, Turin, Italy. Mammalology and Mammalian Taxidermy at the World's Columbian Exposition, Professor L. L. Dyche, Professor of Comparative Anatomy, University of Kansas, Lawrence, Kas.

September 1.—The Cellular Basis of Heredity, Professor E. B. Wilson, Department of Biology, Columbia University, New York City. Continuity of Organization the Basis of Heredity, or the Organism and the Cell, Professor C. O. Whitman, Head Professor of Biology, University of Chicago. Zoological Psychology and the Development of Mind, Professor C. Lloyd Morgan, Professor of Animal Biology in University College, Bristol, England. Zoological Nomenclature as a Means to a End, Dr. Elliott Coues, Washington, D. C. On Zoological Nomenclature, Dr. Charles Girard, Paris, France.

THE INTERNATIONAL CONGRESS OF ANTHROPOLOGY.—August 28-September 2.—Local Committee of Organization.—F. W. Putnam, Chairman, C. Staniland Wake, Secretary, Edward E. Ayer, James W. Ellsworth, H. W. Beckwith, Frederick Starr, Stephen D. Peet. Executive Committee.—Daniel G. Brinton, President, Franz Boas, Secretary, W. H. Holmes, Representative of American Association Adv. Science, W. W. Newell, Representative of American Folk-Lore Society, Otis T. Mason, Representative of Anthropological Society of Washington, Alice C. Fletcher, Representative of the Women's Anthropological Society, Louis A. Lagarde, Representative of United States Army Medical Museum, and the Presidents and Secretaries of the Sections of the Congress.

August 28.—Addresses of Welcome by the President of the World's Congress Auxiliary and others. Reponses in behalf of different Congresses and countries. Address by the President of the Congress, Dr. Daniel G. Brinton. Subject: The Nation as an Element in Anthropology. Physical Anthropology of North America, Franz Boas Anthropometry of North American School Children, Gerald M. West. Crania from Cuban Caves, Carlos de la Torre. Trepanning in Ancient Peru, Manuel A. Muñiz. On the Anthropological Laboratories of the Department of Ethnology at the World's Columbian Exposition, Franz Boas, H. H. Donaldson, Joseph Jastrow.

August 29.—The Discovery of an Artificially-Flaked Flint Specimen in the Gravels of San Isidro, Spain, H. C. Mercer. The Aboriginal American Mechanics, Otis T. Mason. A Résumé of Archæological Investigations in the Champlain Valley, G. H. Perkins. Anthropological Work at the University of Michigan, Harlan I. Smith. The Mexican Calendar System, Mrs. Zelia Nuttall. On the Antiquity of the Civilization of Peru, Emilio Montes. Cave Dwellers of the Sierra Madre, Carl Lumholtz. Orientation, A. L. Lewis. The Tumuli of Hampshire as a Central Group of Mounds in South Britain, J. S. Phené. The Collection of Games in the Anthropological building, Stewart Culin, J. G. Bourke, Frank Cushing.

August 30.—Alleged Evidences of Ancient Contact Between America and Other Continents, Daniel G. Brinton. Bark Cloth: The Primitive Textile, Walter Hough. Love Songs among the Omahas, Miss Alice C. Fletcher. Primitive Scales and Rhythms, J. Comfort Fillmore. A Peculiar Observance of the Quichua Indians of Peru, G. A. Dorsey. Customs among Natives of East Africa, Mrs. M. French Sheldon. Secret Societies among the Wild Tribes, Stephen D. Peet. The Anthropological Collections in the Government Building. A Critical Study of Flaked Stone Implements, W. H. Holmes. An Industrial Exhibit based on Linguistic Stocks, Otis T. Mason. Museum Collections to Illustrate Religious History and Ceremonies, Cyrus Alder. Illustrations of a Zuñi Dramatic Ceremonial, Frank Cushing.

August 31.—Ritual regarded as a Dramatization of Myth, W. W. Newell. The Ritual of the Kwakiutl Indians, Franz Boas and George Hunt. The Walpi Flute Observance; a Study of Tusayan Cermonial Dramatization, J. Walter Fewkes. On the Folk-Lore of Precious Stones, G. F. Kunz. The Fall of Hochelaga; a Study in Folk-Lore, Horatio Hale. The Coyote and the Owl; Tales of the Kootenay Indians, A. F. Chamberlain. Legends of the Bella Coola Indians, Fillip Jacobsen. The Villas of the South Slavs, Friedrich S. Krauss. The Collections of American Archæology in the Anthropological Building. North American Archæology, F. W. Putnam. The Cliff Dwellers, Frank Cushing. Mexican Archæology, Mrs. Zelia Nuttall. Central American Archæology, Manuel M. de Peralta. South American Archæology, G. A. Dorsey. Cache Finds from Ancient Village Sites in New Jersey, Ernest Volk.

September 1.—The Historical Study of Religions; Its Method and Scope, M. Jastrow, Jr. An Ancient Egyptian Rite, Illustrating a Phase of Primitive Thought, Mrs. Sarah Y. Stevenson. On the Sacerdotalism of the Veda, with a Special Reference to the Vedic Hymns, M. Bloomfield. A Chapter in Zuñi Mythology, Mrs. Matilda C. Stevenson. The Religious Symbolism of Central America and its Wide Distribution, Francis Parry. Paper (subject not announced), Grant Bey. Paper (subject not announced), Crawford H. Foy. North American Ethnology, Otis T. Mason. Paraguay, Emil Hassler.

September 2.—The Present Status of Our Knowledge of American Languages, Daniel G. Brinton. Classification of Languages of the North Pacific Coast, Franz Boas. Notes on the Phonology of the Kootenay Indian Language, A. F. Chamberlain. The Affinities of the Egyptian and Indo-European Languages, Carl Abel. Study of the Papuina Language of Central America, Raoul de la Grasserie. The Ethnological Collection in the German Village, Ulrich Jahn. The Pre-Malay Culture of the Malay Peninsula,——Wildman.

THE CONGRESS OF EVOLUTIONISTS.—September 27th 28th, and 29th.—Committee on Organization. Benjamin F. Underwood, Chairman, Lloyd G. Wheeler, Secretary, Professor E. S. Bastin, C. Staniland Wake, J. R. Cummings, Professor E. R. Boyer, Rev. J. Vila Blake, Professor E. G. Cooley, Franklin H. Head, Rev. Jenkin L. Jones, Dr.

Bayard Holmes, Thomas Whitfield, Judge A. N. Waterman. Committee on Programme and Correspondence.—Dr. Lewis G. Janes, Chairman, James A. Skilton, General Secretary, Professor E. S. Bastin, William Potts, J. W. Alfred Cluett, Edward P. Powell, Dr. Robert G. Eccles, Rev. Minot J. Savage, Professor John Fiske, Daniel Greenleaf Thompson, Dr. Martin L. Holbrook, Benjamin F. Underwood, George Iles, Duren, J. H. Ward, Ph. D., Rev. John C. Kimball, Lloyd G. Wheeler.

September 27th.—Opening Address by the Chairman. The Progress of Evolutionary Thought, Benjamin F. Underwood, Illinois. Social Evolution and Social Duty, Herbert Spencer, England. Remarks, By James A. Skilton, New York. Constructive Evolution, Edward P. Powell, New York. Remarks, By Mrs. Celia P. Woolley, Illinois, and Others.

September 27th.—Origin of Variations—Effects of Use and Disuse, Professor Edward D. Cope, Ph. D., Pennsylvania. Evolution of Muscle Fibre—A Microscopical Study, Martin L. Holbrook, M. D., New York. Present Status of Biological Science, Professor Edward S. Morse, Massachusetts. The Inheritance of Acquired Characters—A Botanical Study, Professor E. S. Bastin, Illinois. Weissman's Theory Reviewed, Edmund Montgomery, M. D., Texas. The Marvel of Heredity and its Meaning, Rev. John C. Kimball, Connecticut. Herbert Spencer's Contribution to the Theory of Evolution, Edwin Hayden, Michigan. Charles Darwin—the Man and his Work, Duren J. H. Ward, Ph. D., Pennsylvania. The Poets of Evolution, Mrs. Sara A. Underwood, Illinois. Asa Gray, and America's Contribution to Botanical Science, Professor T. J. Burrell, Illinois. Edward Livingston Youmans, Instructor of the People, Hon. John A. Taylor. The Life-Work of Richard A. Proctor, Miss Mary Proctor, Florida. Emerson, the Prophet of Evolution, William J. Potter, Massachusetts.

September 28th.—The Relativity of Knowledge—Spencer's Unknowable, Benjamin F. Underwood, Illinois. The Relations of Feelings, Herman Gasser, M. D., New York. Evolutionary Psychology as Related to Education, Professor Almon G. Merwin, Ph. D., New York. Constructive Forms of Intuition, John E. Purdon, M. D., Dublin. Psychology in its Relation to Æsthetics, Harvey C. Alford, South Dakota.

September 28th.—The Evolution of the Social Body, Rev. A. N. Somers. Evolution as Applied to Disease in the Progress of Social Development, Bayard Holmes, M. D., Illinois. The Evolution of the Modern Family, Mrs. Florence Griswold Buckstaff, Wisconsin. The

Beastliness of Modern Civilization—Evolution the Only Remedy, Miss Mary A. Dodge ("Gail Hamilton"), Maine. Evolution and the Fair, John H. Copeland, Texas. The Evolutionary Basis of Social Economics, Professor George Gunton, New York. The Relation of Evolution to Political Economy, Charles S. Ashley, New York. Some American Problems of Evolutionary Economics, James A. Skilton, New York. Universal Economic Progress, as Related to Ethical Economy, Alfred W. Smith.

A Symposium of Brief Papers on the following Questions: I. Does the doctrine of evolution, in its sociological aspects, in your opinion, offer wise suggestion for the solution of the grave social and economic problems of our time. II. What, in your judgment, in accordance with such suggestion, should be the next step taken, in our own country, looking toward the solution of these problems? Professor John Fiske, Massachusetts; Edmund Montgomery, M. D., Texas; R. W. Shufeldt, Washington, D. C.; Rev. Myron Adams, New York; Star Hoyt Nichols, New York; F. M. Holland, Massachusetts; Benj. B. Kingsbury, Ohio; T. B. Wakeman, New York; Robert Matthews, New York; L. R. Klemm, Ph. D., Washington, D. C., Bayard Holmes, Illinois, and Others.

September 29th.—Involution and Evolution, Professor Elliott Coues, Washington, D. C. Abstract of Paper on Monism (translated), Professor Ernst Haeckel, Jena, Germany. Evolution of Cosmic Matter, R. G. Eccles, M. A., New York. The Law of Evolution in the Spiritual Realm, Wm. Emmette Coleman, California. The Knowable and the Unknowable, Sylvan Gray, New York. Philosophy and the Aoctrine of Evolution, Raymond S. Perrin, New York. Evolution Optimistic, W. Alfred Cluett, New York. Influence of the Doctrine of Evolution on Ethical Sanctions, Rev. Minot J. Savage, Massachusetts. Intellectual Relations of Morality, C. Staniland Wake, England. Herbert Spencer as a Teacher of Ethics, Rev. Jenkin Lloyd Jones, Illinois. Professor Huxley's Surrender, Dr. Lewis G. Janes, New York. The Evolution of Morality, Rev. H. A. Simmons, Minnesota. The Morals of Evolution, James T. Bixby, Ph. D., New York. The Relations of Evolutionary Thought to the Belief in Immortality, Dr. Charles T. Stockwell, Massachusetts. The Evolution of the Old Testament Religion, Rabbi Emil G. Hirsch, Illinois. The Evolution of Apostolic Christianity, Rev. Howard MacQueary, Michigan. Christianity, in the Evolution of Religious Thought, Rev. Frank N. Riale, Ph. D., New York. The Future of Religious Evolution, Edward P. Powell, New York. The Higher Evolution, Celestia Root Lang, Ohio.

SCIENTIFIC NEWS.

The death is announced of Prof. Alexander Strauch, director of the Zoological Museum of St. Petersburgh, and author of several works on Zoology. Prof. Strauch was an authority on reptiles.

According to the Revue Scientifique Dr. R. Lydekker started early in August to La Plata, to visit the Natural History Museum of that city. As they go by invitation from M. Moreno, the direcrto of the museum, they will have an opportunity of studying the rich paleontological collections from southern Patagonia which the institution has acquired during the last few years.

Mr. W. F. C. Gurley has been appointed director of the Geological Survey of Illinois by Gov. Altgeld. Mr. Gurley is the author of several papers on paleozoic paleontology, and has a very valuable collection of fossils.

Prof. E. D. Cope has been appointed Professor of Comparative Anatomy and Zoology in the Biological School of the University of Pennsylvania; and Prof. A. P. Brown Professor of Geology and Mineralogy in the Auxiliary Medical Faculty of the same institution.

W J McGee has been appointed Director of the Bureau of Ethnology of the United States.

The distinguished French physician, Charcot, is dead. He had an immense practice in Paris and France, and he will be long known for his researches in hypnotism.

In view of the recent meeting of the Pan-American Medical Congress in Washington, D. C., and of the prospective meeting of the Coggress of American Physicians and Surgeons in Washington, D. C., in May, 1894, the Executive Committee of the Association of American Anatomists think it advisable to postpone the next meeting of the Anatomists from December, 1893, until May, when the Association will meet as an integer of the Congress.

A work in folio on the Forest Flora of New South Wales is in preparation, and will soon be issued by the Forest Department of that province. It will be published in quarterly parts, each containing five plates, with their corresponding letter-press of descriptive matter. The illustrations will be in color, and show natural sized flowering branchlets of each species, together with their fruits, barks, etc. Judging from the title page, the work will be an exceedingly beautiful addition to a library.

A volume of scientific memoirs in honor of the late Sir William Macleay has been published by the Linnean Society of New South Wales, and by Dulau & Co., London. It is a royal quarto of 290 pages, with a portrait and forty-two plates and comprises the following papers: The Hon. Sir William Macleay, Kt., F. L. S., M. L. C.; Contributions to our Knowledge of Ceratodus, Part I.—The Blood Vesssels, Prof. W. Balwin Spencer, M. A. (Plates i–v); The Pliocene Mollusca of New Zealand, Prof. F. W. Hutton, F. R. S. (Plates vi–ix); A Monograph of the Temnocephalæ, Prof. W. A. Haswell, M. A., D. Sc. (Plates x–xv); On an apparently New Type of the Platyhelminthes (Trematoda ?), Prof. W. A. Haswell, M. A., D. Sc. (Plate xvi); Observations on the Myology of *Palinurus edwardsii* Hutton, Prof. T. Jeffery Parker, D. Sc., F. R. S., and Josephine G. Rich (Plates xvii–xx); Observations upon the Anatomy of the Muzzle of the Ornithorhynchus, Prof. J. T. Wilson, M. B., Ch. M., and C. J. Martin, M. B., B. Sc. (Plates xxii–xxiii); On the peculiar rod-like Tactile Organs in the Integument and Mucous Membrane of the Muzzle of Ornithorhynchus, Prof. T. J. Wilson, M. B., Ch. M., and C. J. Martin, M. B., B. Sc. (Plates xxiv–xxvi); On *Parinacochlea fischerii* Smith, C. Hedley, F. L. S. (Plate xxvii); On the Geographic Relations of the Floras of Norfolk and Lord Howe Islands, Prof. R. Tate, F. L. S., F. G. S., etc.; Notes on an Undescribed Acacia from New South Wales, Baron von Mueller, K. C. M. G., M. & Ph. D., LL. D., F. R. S. (Plate xxviii); Description of a New Hakea from Eastern New South Wales, Baron von Mueller, K. C. M. G., M. and Ph. D., LL. D., F. R. S. and J. H. Maiden, F. L. S., F. C. S. (Plate xxix); A Description of some of the Weapons and Implements of the Alligator Tribe, Port Essington, North Australia, R. Etheridge, Jun. (Plates xxx–xxxv); New Nematodes from Fiji and Australia, N. A. Cobb, Ph. D. (Plates xxxvi–xlii).

The annual Excursion of the Geological Society of France for 1893 covered the region at the Nothern base of the Eastern Pyrenees. The region presents a great deal of interest to the Geologist and is remarkably complex, embracing Archean, Mesozoic and Cenozoic beds of several systems.

The Naturalist attached to the Antarctic Sealing and Whaling fleet that recently sailed from Dundee, Scotland, have returned and sent in their reports. They had few opportunies of landing on the supposed Antarctic continent, but they obtained specimens of Eruptive and Schistose rocks, and some fossils of Jurassic age.

DEC 15 1893

THE

AMERICAN NATURALIST

VOL. XXVII. December, 1893. 324

NOTES ON THE COCHINEAL INSECT.

BY T. D. A. COCKERELL.

The following notes have been put together in the hope that they may tend towards a better understanding of the genus *Coccus*, as now restricted. Notwithstanding the voluminous literature on the subject of cochineal, it cannot be said that the insect producing this substance is adequately known to entomologists, or that the affinities of the genus in which it is placed are altogether well understood.

At the outset we have to inquire, what is *Coccus cacti?* According to Watt (Dict. Econ. Prod. India, Vol. II), it was discovered by the Spaniards in Mexico in 1518, but was not made known in Europe until 1523. The name *Coccus cacti* seems to have been applied to it as early as 1651 by Hernandez, but of course the species is now credited to Linné.

Coccus cacti Linné, as understood by its author, is simply the cochineal-producing insect found on cacti in Mexico. It need hardly be said that minute details, such as are now considered of generic and specific importance in the Coccidæ, were not taken into account in the definition of the species.

In the present century, however, it began to be suspected that there was more than one species. Signoret, writing about twenty years ago, mentions three segregates from the old *C. cacti*, namely, *C. tomentosus* Lam., *C. bassi* Targ., and *C. sylvestre* Thierry de Meronville. These, he says, are supposed species, based on specimens from Mexico, presenting differences in color and the amount of cottony matter.

In the same work (Essai sur les Cochenilles) Signoret gives a definition of *C. cacti* which may be taken as fixing the strict application of the name. Properly, therefore, the insect is *Coccus cacti* L., sens. Sign., and its principal characters are as follows:

Female. Dark red-brown, 6 to 7 mm. long, 4 wide, 2 to 3 high, with a great quantity of white cottony matter. Segmentation distinct. Back more or less keeled. Antennæ short, conical, 7-jointed, the four basal joints short, wider than long; joint 7 as long as the two before it together. Larva with 6-jointed antennæ.

Male. Red-yellow, legs and antennæ brown. Antennæ 10-jointed, hairs on antenna knobbed.

In Ashmead's Generic Synopsis of the Coccidæ, the genus *Coccus* forms a tribe Coccini, distinguished from the tribe Acanthococcini by no very tangible characters. It is stated that the male is apparently without ocelli (see however, Signoret's figure) and the adult ♀ lacks the bristles on the anal ring. Maskell (New Zealand Scale Insects) had earlier placed *Coccus* in a subdivision by itself, defined thus: "Adult females active, covered with mealy secretion; antennæ of seven joints; no hairs on anogenital ring. Eyes of male not facetted."

The question as to there being two or more species, after being answered in the negative by Signoret, was again raised in 1884 by Lichtenstein. This entomologist had received specimens from Mexico which he considered to be the *Coccus tomentosus* Lam.; but he not only regarded this species as distinct from *cacti*, but transferred it to *Acanthococcus*—a genus known hitherto only from Europe and New Zealand.

The nomenclature of the Cochineal insects, according to the latest researches, is, therefore:

Tribe COCCINI. Genus COCCUS L., Sign.
Coccus cacti L., Sign.
Tribe ACANTHOCOCCINI. Genus ACANTHOCOCCUS Sign.
Acanthococcus tomentosus (Lam.) Licht.

So the genus *Coccus* would still remain monotypic, were it not that in 1888 Mr. Douglas described a *Coccus agavium*, found on *Agave*—not a cochineal insect. It is true that the recent literature contains some other nominal species of *Coccus*, such as *C. laniger* W. F. Kirby, 1891, but in so placing them, their authors have reverted to the Linnean use of the term, ignoring genera as now defined.

From an examination of cochineal insects from Jamaica, Mexico, and New Mexico, I have come to the conclusion that the above-mentioned definition and classification need entire revision. This conclusion may be wrong, and was only reached with much hesitation—but it seems sufficiently clear after considering all the evidence.

The specimens examined are:

1. From the Parade Garden, Kingston, Jamaica, on *Opuntia*: =*Coccus cacti* L.
2. From Silao, Mexico, on *Opuntia tuna*, from Dr. A. Dugès: =*Coccus tomentosus* Lam.
3. From Guanajuato, Mexico, from Dr. A. Dugès:=*Coccus tomentosus* Lam.
4. From Las Cruces, New Mexico:=*Coccus confusus* n. sp.

The Silao insect is Lichtenstein's *Acanthococcus;* there can be no doubt about this as Lichtenstein had his specimens from Dr. Dugès, who assures me they are the same. All the others, however, are strictly congeneric with this, and therefore either *Acanthococcus tomentosus* is a *Coccus*, or all belong to *Acanthococcus*.

Acanthococcus, as stated above, has been recorded from Europe and New Zealand. Maskell sinks the genus as a synonym of *Eriococcus*, which he defines thus:

"Adult female enclosed in an elongated sac of white or yellow felted cotton; body elongated, segmented; anal tubercles conspicuous; feet and antennæ present; several rows of conical spines on dorsal surface. Antennæ of six joints." The anogenital ring is also said to have hairs.

This does not precisely agree with *C. tomentosus*, but on comparing that insect with the published descriptions of *Eriococcus* spp., the affinity is evident.

The Jamaican specimens agree very closely with *Coccus cacti*, but are certainly of the same genus as *tomentosus*. If they are not *C. cacti*, they represent a new species exceedingly like it—a view of the case which seems wholly untenable.

The conclusion, therefore, at which I arrive is that *Coccus*, as typified by *C. cacti*, is a genus very near to *Eriococcus*, and not by any means to be separated as a different tribe. Also, that the cochineal insect includes three or more closely allied species or races. It will be useful to consider the characters in detail.

COCCUS L., Sign.

Adult Female.

Size.—*Coccus cacti*, according to Signoret, is from 6 to 7 mm. long. *C. tomentosus*, from Guanajuato, varies from 3½ to nearly 5 mm. in length.

Shape.—The species are broadly oval; the keel seen by Signoret is more due to shrinkage in drying than anything else. *C. tomentosus* may be described as hemispherical, with the hind end a little pointed.

Color.—All give the characteristic cochineal color, and so far as this is concerned, I see little difference. *C. tomentosus* placed in caustic soda without heating, gives a beautiful reddish-violet color; on boiling, this turns bright crimson. This was observed in Guanajuato specimens; of Silao examples I noted that heated in caustic soda they gave a magenta color, very strong, which, by transmitted light, was bright violet, like logwood staining.

C. confusus, boiled in soda, gave a very fine, bright carmine.

The under surface of *C. tomentosus*, where free from secretion, appears dark purplish in the living insect. Signoret says *C. cacti* is dark red-brown; those from Jamaica are better described as dark greyish. In Ency. Brit., 9th Ed. (1877), the ♀ of *cacti* is described as dark brown. *C. cacti* has been introduced in Madeira, and I found it there on *Opuntia* in 1879. I have a water-color drawing made of it at the time, and it is represented as dark bluish-gray, not at all reddish.

Secretion. The secretion is better described as cottony than mealy. As noticed by Signoret, it differs in the several races, and these differences cannot be held to have generic value. In *C. confusus* and the Jamaican *C. cacti*, the secretion is profuse, so that the individuals are hidden in it, and separated with difficulty. In the Madeira *C. cacti*, it is much more sparse, allowing the gray color of the females to be seen. In *C. tomentosus* it forms a sac covering the insect, after the manner of *Eriococcus;* in the smaller specimens, part of the body below is free, but larger ones are entirely covered by secretion. The individuals of *C. tomentosus* in their woolly sacs, are easily separable from one another.

Activity.—Maskell writes for *Coccus*, "adult female active;" as against the stationary females of *Eriococcus*, etc. This supposed character is valueless; the final state of female *Coccus* is one of inactivity.

Antennæ.—The antennæ are very small, and show plain evidence of degeneration. In *C. cacti* from Jamaica I could plainly see the seven joints; the first large, the second broad and very short, the third longer but still broader than long, the fourth perhaps as long as the third but not so broad, the fifth and sixth about as broad as long, and the seventh decidedly longer than broad, rounded, emitting two or more hairs. All this agrees excellently with Signoret's *cacti*.

C. tomentosus also shows seven joints, practically as in *cacti*, except that the fourth joint is longer in proportion. *C. confusus* has the antennæ more degenerated, five-jointed, all the joints broader than long except the last; third shortest, last emitting about seven hairs.

Legs.—In *C. confusus* I found all the legs present and well-developed, though small. Femur about as long as tarsus and tibia; tibia decidedly *shorter* than tarsus. In *C. tomentosus* the legs are stouter than in *confusus*, the tibia about as long as the tarsus, but if any difference, the tibia is the shorter. Femur very stout, and about as long as tarsus and tibia. The tibia is broader than the tarsus; the claws large. The usual knobbed hairs at end of tarsus are present.

Truncate Spines.—The skin of all three species shows numerous truncate processes, which no doubt represent the spines of the larva and of the species of *Eriococcus*. These processes consist of two parts, a broad ring-like basal part, and a cylindrical sharply truncate terminal part. In *C. confusus* these processes are decidedly more slender than in *C. tomentosus,* the latter being characterized by their great thickness. In *C. cacti* from Jamaica they are also thick, practically as in *tomentosus.*

Grouped Orifices.—Little groups of glands, like those of the Diaspinæ, are seen among the spines. These groups are compact and very clearly circumscribed, and are quite obvious in *C. cacti* (Jamaica) and *C. confusus.* In the latter, some groups are of three orifices only, but usually there are many, perhaps averaging about 15.

Viviparous Habit.—*C. confusus* was found to have the body full of well-formed larvæ. *C. tomentosus,* from Silao, which had been long in alcohol, were full of larvæ.

Immature Stages.

Color.—The young of *C. tomentosus* are reddish-purple.

Antennæ.—I found 7 joints in the second stage of Jamaican *C. cacti.* In *C. confusus* there *seem* to be 7 joints in the larva, but two are, perhaps, to be considered false joints; these are in joints 1 and 3. The second, first and fifth (or last) are about equal, the third and fourth shortest. The last four joints emit hairs, one on the fifth being especially long. The antennæ of *C. confusus* appear to degenerate with the growth of the insect.

In the larva of *C. tomentosus,* I found the antennæ 5-jointed, the proportions of the joints as in *Confusus.* The false joint in joint 1 is noticed, but it is evidently not a true joint. Joints 3 and 4 have a peculiar shape, concave on one side, convex on the other. The last joint has four hairs, two of which are long.

The larva of *Coccus* is commonly said to have 6-jointed antennæ. According to Signoret's figures, that of the ♀ has 6 joints, that of ♂ only 5.

Legs.—The legs are, of course, much better developed in the larva than the adult, in proportion to the size of the insect. In the leg of a larva of *C. confusus,* I noticed two strong bristles on the inner side of tarsus, and one at distal end of tibia. Tibia shorter than tarsus, but not so much so as in the adult, thus reversing the usual order of events.

In *C. tomentosus* I noted, legs of larva with long claws, and longer tarsal hairs, tibia shorter than tarsus. In Jamaican *C. cacti*, second stage, I noticed the length of the claws.

Rostral Filaments.—In the very young larvæ of *C. confusus* and *C. tomentosus*, the rostral filaments are coiled like the spring of a watch, and very conspicuous.

Anogenital Ring.—The absence of hairs on the anogenital ring is given as a generic character of *Coccus*; but these hairs, about six in number, were plainly seen in the second stage of Jamaican *C. catci.*

Spines.—All three species have in the larva distinct rows of spines, which run longitudinally down the back, just as Signoret figures for *Capulinia sallei.* In *C. tomentosus* I found two parallel dorsal rows, and two rows on each side of the anterior part of the body, joining to form one row on the posterior half. These spines have sharp points, differently from the truncate processes of the adult.

Male Sac.—In *C. tomentosus*, this is white, elongated, about 1½ mm. long. In Jamaican *C. cacti* it is quite similar.

Adult Male.

Size.—In *C. tomentosus* the body is about 1 mm. long.

Color.—The male of *C. cacti* is said to be red-yellow (Signoret) or deep red (Ency. Brit., 9th Ed.). A male of Jamaican *C. cacti*, after being boiled in soda, showed the thorax and genitalia pale brownish, the abdomen pink. In a male not so treated, the wings were observed to be white, appearing granulose, about half their length extending beyond the body.

In a living male of *C. tomentosus*, the body was dark purple-red, the wings whitish subhyaline, the veins not colored. Crushed under a cover-glass, the body gave a brilliant magenta color.

Caudal Filaments.—The abdomen of *C. cacti* from Jamaica emits two very long filaments. *C. tomentosus* also shows a pair of long white filaments.

Antennæ.—These are 10-jointed, as observed in Jamaican *C. cacti*, and *C. tomentosus.* The two first joints are comparatively short. I noted of *C. tomentosus:* joint 2 subglobose, 3 longest, fusiform; 4, 5 and 6 fusiform, equal, distinctly shorter than 3; 7 *slightly* shorter than 6; 7, 8, and 9 subequal; 10 about as long as 4. Joints with whorls of hairs. Antennæ dark reddish, but last joint pale pink. The Jamaican *C. cacti* showed about the same, but 4 longer than 5. I saw no knobbed hairs.

Signoret says the antennæ of *cacti* are brown, and in his figure the fourth and fifth joints are longer, if anything, than the third.

Legs.—I noted of *C. tomentosus:* claw long and straight; digitules very slender, filiform, hardly knobbed. Tarsal knobbed hairs well-formed, rather stout. Tibia and tarsus with a row of strong short spines on inner side. Tarsus about two-thirds length of tibia; tibia a little shorter than femur; trochanter with a long hair.

Scutellum.—The scutellum in Jamaican *C. cacti* exhibits a distinct median longitudinal furrow.

Conclusions.

1. Pending the discovery of new facts proving otherwise, I would propose to unite the tribes Acanthococcini and Coccini under the latter name.

2. The genus *Coccus* may be re-defined as consisting of species which have rows of dorsal spines in the larva, truncate dermal processes in the adult female, antennæ 7- or 5-jointed in the ♀, 10-jointed in the ♂, 5- or 6-jointed in the larva, and in the ♀ more or less abundant cottony secretion. The absence of bristles on the anogenital ring of the adult ♀ may also be cited; it was on this ground that Dr. Riley, to whom I sent *C. tomentosus*, objected to its inclusion in *Acanthococcus*, the latter genus having the bristles.

3. The cochineal insect, as commonly understood, may be taken to include three closely allied species, *C. tomentosus* Lam., *C. cacti* Linn., *C. confusus* Ckll., separated by the characters given above. Former records of the occurrence of *C. cacti*

must be held more or less doubtful until specimens are re-examined.

4. *Coccus* may be held to include only the cochineal insects. *Coccus* (*Gymnococcus* Dougl.) *agavium* seems seems to belong to a separate genus, and may be known as *Gymnococcus agavium*.

5. *Capulinia* seems to be a very closely allied, but still more degenerate genus.

Agricultural Experiment Station, Las Cruces, New Mexico, October 22, 1893.

BACTERIOLOGY IN ITS GENERAL RELATIONS.[1]

BY H. L. RUSSELL.

(*Continued from page 859.*)

Quite naturally, the practical application of bacterial research has been primarily directed along the lines of medicine and the industrial activities. In any new branch of scientific progress, this is almost invariably the case. Our interest in the subject is largely measured by what it is worth to us, and in proportion as it fills this function do we estimate the importance of its study. The results that have already been accomplished in bacteriology have not however been entirely confined to the applied side of the subject. The cause of pure science has also been greatly advanced in various ways. The correlation of any branch of science with allied subjects is to-day so intimate that any discovery in one, often furnishes valuable suggestions in kindred lines of research. It is in this light that we may consider the effect that bacteriology has had upon the greater subject of biology, taken in the pure not the applied sense, and if possible point out some of the lines which seem to promise a rich fruitage from a general biological standpoint. It can hardly be expected that so young a member of the biological family could as yet have contributed much to the common fund that all its workers are striving to accumulate, yet it may with justice be said that the circle of its influence has widened much beyond its own particular sphere. Perhaps the most valuable of the contributions to its sister branches has been in its *technique.* This influence has been most strongly marked in the closely related departments of botany. The excessive minuteness of bacterial forms and the ubiquity with which these organisms are distributed made it absolutely necessary that some reliable means of pure cultures should be introduced before much real advance could be made in this subject. In bacteriology; this found its greatest development in the employment by Koch, of gelatin as a transparent solid medium for the isolation and cultivation of germs. Some features of this method had been anticipated by other workers, especially Klebs.

---

[1] Delivered before the Biological Club of the University of Chicago, Feb'y, 1893.

This method enables the experimenter to isolate the form he desires to study from any mixture of different species, and by cultivating it in sterile media, a pure culture derived from a single germ can be obtained which is made the basis of definite morphological and physiological study. Brefeld's methods of studying the morphology and developmental history of the fungi are essentially the same as the bacteriological culture methods. He first obtained his pure cultures by dilution until he had a single germ. Later he added the use of gelatine or other transparent ingredients as a means of isolating and fixing the developing organism. The results of these studies which now fill ten large quarto volumes, are among the greatest contributions to mycology, that this century has produced. He refused to admit the validity of the classic descriptions that had been based upon material gathered under natural conditions, maintaining that the systematic part of the science was full of errors, that had arisen from the examination of imperfect mixed growths, and the separation of different growth-forms into individual species.

Basing his opinion upon the only scientific foundation, that we must know the *complete* life history of a form before we can intelligently study its phylogenetic affinities, he made his observations upon pure cultures grown from a single spore in sterile nutrient media. These he kept from the original spore until in many cases the fruiting process had been completed. By this method he was able to settle definitely many disputed points concerning the value of certain form-genera and species. These conclusions of Brefeld, based upon the single cell, pure culture method, have revolutionized the entire classification of the great group of fungi and the theories as to the phylogenetic affinities of different groups have been greatly modified. Hansen adopted the same method in his study of ferment organisms, more especially the yeasts, and this plan of pure culture growths has settled many controversies in the biology of this imperfectly understood group. Beyerinck applied the gelatin method in the isolation of algæ and succeeded in cultivating a number of free unicellular forms, some symbiotic species in certain hydra and paramœcia, and a number of the gonidia in lichens. So far all attempts to apply the isolation methods of solid media to animal life have proven futile. Strenuous efforts have been made upon such parasitic forms as the malaria plasmodium and other parasitic protozoa, but as yet these experiments have not been successful.

With respect to tinctorial methods, bacteriology has been of service. The art of staining to bring out structural differences more clearly has been systematically developed in the latter half of the present century. The discovery of aniline colors in the seventies gave an additional impulse and the names of Koch, Ehrlich, and Weigert will always be associated with the rapid advance and development of this branch of biological technique. The necessity of staining in order to differentiate bacteria in animal tissue has been so imperative, that much time and effort have been expended in order to improve the old, and discover new processes. The success of these efforts has been stimulating in other lines of work, and has materially advanced the general knowledge of stains.

Koch in 1878, was one of the first to apply photography to the study of microscopic preparations. The application of this process by means of photograms for class demonstration, and the obvious advantages that it possesses for accurate illustration are apparent. The recently completed photomicrographic atlas of bacteria by Fränkel and Pfeiffer exemplifies the degree of excellence that has already been attained in this branch.

In the study of bacterial forms, the old types of microscopes were entirely inadequate. The necessity of improved instruments, in regard to definition and resolution to work out the structure of these "infinitely little" organisms, acted as a healthy stimulus on the art and science of lens making. The perfected instrument of to-day, with its homogeneous immersion, the Abbe condenser, and the apochromatic objective, are largely the result of the demand of bacteriologists. These points suffice to show the influence that the study of the bacteria has exerted upon the technique of other lines of biological thought.

Has it been able to any extent to aid in the solution of any of the general questions that have from time to time engaged the attention of all students of living phenomena? In considering this, reference will be made mainly to those lines that are of special importance in the theoretical problems of biology. As has been previously stated, the main results of bacteriology as yet are found in applied science, but the germ theories of fermentation, of nitrification, of sewage filtration, of nitrogen fixation, of the etiology of contagious diseases and of inflammation are monumental witnesses of the value of this department in the realm of pure science.

Bacterial methods in the hands of the illustrious Pasteur were the means of combatting and effectually routing the heterogenists from their defence and proving beyond the shadow of a doubt, the accuracy and universality of the Harveian motto " *Omne vivum ex vivo.* "

Since the discovery of the laws, which are the foundational basis of the doctrine of evolution, every department of natural science has paid tribute to it, adding fact upon fact, and broadening the basis of the principles, formulated by the observant Darwin. Morphology and physiology in both branches of biology, as well as pathology, have furnished their quota of proof in this grand advance step in knowledge. Has bacteriology contributed its contingent to the general result on this and other vital problems? Does the testimony of the infinitely little corroborate that of the higher and more complex forms of life?

The advantages of this group as types for study on many questions of this nature, have not as yet been generally appreciated. The practical side of the subject has naturally presented the most attractive phase, and even the systematists have found but scant encouragement for their labors, except for the utilitarian purpose of species determination.

The number of observers who have made this group of organisms a subject of special study with reference to general biological laws have been but few. Valuable data have however, often been obtained in an incidental way. The possibilities, which this group of organic life offers for the study of many of these general problems, are so noteworthy that it seems worth while to call attention to them more in detail. In selecting forms for the study of certain questions, the biologist chooses, as far as possible, the primitive generalized types upon which to base his observations. Specialization of form and function complicate the conditions and render it more difficult to apprehend the fundamental truth. In this respect bacteria occupy a unique position. Morphologically considered, they are a lowly organized and generalized type, while functionally, they possess a marked degree of specialization.

With our present appliances but little difference can be detected in form between many species that possess widely divergent physiological functions, so that species are often found that are morphologically similar and their dominant physiological function may be expressed either in pigment production, fermentative action, or in an infectious malady.

A certain degree of adaptability in an organism is also necessary if we are to subject it to prolonged experimentation. Many plants and animals are so susceptible to any modification in their surroundings that they cannot well be utilized for purposes of experimentation, a slight change often being sufficient to produce a cessation of the vital functions. Bacteria possess an adaptability not to be found in any other class of organisms. With a large proportion of these forms, the range in temperature of the limits of growth far exceeds any of the higher forms of life.

The majority of species are able to vegetate between 10° C. and 50° C. while exceptional ones grow at the freezing point and others thrive at a temperature of 70° C. This tenacity of life, far surpassing all other forms of animate nature, is as distinctive in the chemical as in the physical environment of these germs.

Another peculiar characteristic, that renders them of especial value from an experimental standpoint, is their rapidity of multiplication. A single cell is the progenitor of millions in twenty-four hours. We can therefore accumulate the effect of certain external influences upon an almost infinite series of generations within a limited time. The time element, which in higher forms of life often necessitates the extension of experiments over a period of years owing to the relative slowness of reproduction, is here minimized to such an extent as to be brought entirely within the limitations of a single observer. By a rapid successive transference of cultures to fresh media, we can secure the effect of an experiment covering an immense number of generations within a limited space of time. Of course, the absence of sexuality in the reproductive process narrows the sphere of investigation, but there is no valid reason why as valuable results may not be obtained by experimental work on problems of variation and heredity as have been already accomplished with asexually propagated plants, like the sugar cane, banana, and potato. The objection that might be raised, that the morphological and physiological characters are more plastic, and therefore more easily modified than higher specialized forms of life, seems to be answered when we take into consideration the number of generations that intervene between the original type and the establishment of a pronounced variety. The gardener is able to modify the constitution of his plant by cultivating it under special conditions for a few years to such an extent that he produces a horticultural variety in a limited number of generations. The bacteriologist in his "microscopic horticulture" finds it far more difficult to modify his species to the same extent in a limited number of generations.

The ease with which experimental conditions can be modified in the manipulation of bacteria is also a valuable factor. The physical and chemical environment can be so rigidly controlled that the variability of conditions which is so disturbing a factor in experimental work on higher forms is practically excluded.

These are some of the evident advantages that bacteria possess for experimental research in evolutionary biology. It may be proper in this connection to state a few of the results which have been obtained in this field and which bear more or less directly upon some of the more general questions of biological importance. As has been before intimated, so little direct attention has been given to this subject, that we are scarcely able to predict what results may be expected from the study of these problems from a bacteriological standpoint.

But few laws in nature have a wider expression than that of variation. In fact, it may be said to be co-extensive with life itself. Among the higher complex forms, no two individuals are exact counterparts of each other, but as one passes from the higher to the lower forms of life, the individual differences gradually become obliterated in the more generalized types, and a greater uniformity seems to prevail among the different members of the same species. In such simple protoplasmic elements as the bacteria, all individual variation is concealed, yet, it is presumably present, and were our facilities for recording such infinitesimal variations, sufficient, we would be able to detect structural and functional differences in each cell.

It is too early for us yet to say, whether the evidence that bacteriology may yield will be in favor of the "innate tendency of species to vary," or whether we are to regard variation as an "expression of the influence of environment." An almost untrodden field is before us which lends itself readily to experimental conditions and it is highly important that we interrogate Nature through the medium of investigation upon her more minute, as well as her larger forms of life.

Structural modification expressed either in change of external form or internal characters is usually made the basis for specific differences, so that classifications have been built more upon morphological, than upon physiological characters. A modification then of characters possessing a morphological value would be indicative of a profound change in the constitution of an organism. How far this would be appreciable in the case of bacteria is not definitely settled. A certain amount of form variation, (much more in some species than in others) is to be seen when different media are used for cultivation. Whether these manifestations are merely modifications due to nutrition or not, it is difficult, if not impossible to say. The question may fairly arise, whether they are due to variations in the food medium or are they entitled to the dignity of varieties and species in the taxonomic sense.

Reproduction is considered one of the most complex and deep seated phenomena of organic life. If we are able experimentally to change the inner constitution of an organic structure to such an extent as to permanently modify its reproductive function, we may justly conclude that a profound change in the original type has been induced. This has been done in the case of the anthrax fever germ. The bacillus that causes this malady is characterized by the ease with which endospores are produced. With a favorable temperature and free oxygen, spores are formed in the vegetating filaments in the course of from 24 to 36 hours. Roux succeeded in producing an asporogenous race of this bacillus by growing them in a nutrient culture medium to which potassium bichromate had been added in the proportion of 1 to 2000. He also succeeded in modifying this reproductive function by the use of phenol. Cultures containing 6 parts of phenol in 10,000 produced endospores in a normal manner, while those seeded in 20 parts to 10,000 were destroyed. Between these limits, the cultures maintained their vitality and grew, but in no case formed spores. When these asporogenous cultures were re-seeded into normal media, they vegetated in a normal manner but did not form spores, although the conditions were most favorable for the process. Behring succeeded in obtaining the same results by the use of rosolic acid. What these observers accomplished by the strict control of cultural conditions, Lehmann observed under more natural conditions. He found that certain cultures that had been cultivated in Koch's laboratory for many generations on gelatine exclusively had lost their ability to produce spores, but their virulence had not been impaired in the least degree. They could not be distinguished from the normal spore-bearing forms in any other than this particular. He tried to modify these varieties, and when the asporogenous type had been grown on a medium suitable for spore production, like potato, for a series of generations, he finally succeeded in producing forms that contained minute spherical refringent bodies, which in some cases externally resembled true endospores, but *biologically* differed from them materially as they were destroyed by heating for two hours at 60° C while the normal endospores are among the most resistent bodies known. This is a well authenticated instance, where the morphological character of reproduction has been modified, while the salient physiological features of the germ remained constant. This change had evidently been brought about through the influence of exterior conditions, and so deeply had the inner constitution of the germ been affected that it transmitted the character to its progeny although the normal conditions of development did not favor its production.

Were we to admit the evidence of physiological variation, we would find abundant proof among the bacteria that this group of organisms were more or less profoundly modified in their functional characters. Physiological variations have so far received but slight attention at the hands of biologists, but in bacteriology the truth of De Varigny's words that species must be defined not only by means of their anatomical characters, but also in terms of physiological differences, has been amply confirmed. Bacteriology has been forced to add physiological to the morphological diagnosis in the study of these minute forms.

That there is a variation in the characters of certain forms in a perfectly natural state is readily seen in the case of some contagious diseases like cholera. It is known that the peculiar individualities of the cultivations isolated from the different epidemics are so marked, that an expert can tell at a glance whether the culture in question descended from the germ found in the Naples outbreak, or in Egypt, or from India. As one epidemic is often the result of the transference of germs from another, and the two germs therefore more or less related, it is reasonable to infer that environment has much to do with their modification. But we are not confined to the evidence of physiological variation as afforded by examples under natural conditions. These conditions are too fluctuating and variable. It is only under rigid experimental control that we can obtain positive proof on this question.

The most noteworthy changes are those that show a decided modification of the physiological function of virulence. Nearly every species belonging to the pathogenic class is subject to greater or less variation in this respect. Anthrax fever, the classic example in bacteriology, has been shown by the experiments of Chauveau to vary in virulence to such an extent that from the original virulent culture, varieties or races have been grown that possess every shade of virulence from the deadliest type to that which is perfectly innocuous. These attenuated types maintain their newly acquired function in a perfectly constant manner, so that we have races of the germs that are christened " mouse anthrax," because they are pathogenic for mice only; others less attenuated are able to kill guinea pigs or rabbits, while still others are virulent for all classes of susceptible animals.

With many germs the variation of this functional property occurs quite readily in cultures under ordinary conditions, as in the case of pneumonia and hog cholera, where all degrees of virulence may be found. Sometimes abnormal conditions of environment seem to be necessary to produce the variation. These modified forms may persist only so long as the artificial conditions are maintained, reverting to the original type when restored to their normal environment, or in some species the constitutional characters of the germ are so changed that they are perpetuated although the conditions favorable to atavism are present. What is true concerning the variation of the pathogenic function is likewise true in regard to other physiological characteristics.

The chromogenic property of certain forms has usually been considered of diagnostic value, but in some instances spontaneous sports occur, as in *Bac. pyocyaneus* α and β, where the only observable difference is that the pigment produced in one is a bluish green, while in the other it is a fluorescent green, and quite distinct from the first. This species has been modified artificially so that the color producing power of the organism has been permanently abolished. From other chromogenic species like *Bac. prodigiosus,* the germ that causes "bleeding bread" and *Bac. cyanogenus,* that which provokes the disturbance known as "blue milk," varieties have been produced by constant selection and cultivation of cultures in which the color producing quality of the germs entirely disappeared. Laurent modified the chromogenic function of the Kiel water bacillus by exposing it to direct sunlight for a limited time. The suppression of this peculiarity was transmitted from generation to generation so that a perfect albinotic variety was formed. The color property was also lost when cultivated at blood heat and was not regained when continued cultivation was carried on at lower temperatures. These examples indicate the plasticity of this physiological function of color production and show the influence that is exerted upon the germ by a continued subjection to certain experimental conditions.

The objection may be raised that these cases that show a change in the various vital functions do so because their vitality is impaired and that the variety so produced is merely a degenerated and weakened type. While this may be true in certain cases, it does not detract from the value of such experiments as throwing more light upon the question of environmental influence. Besides, the rule is by no means general that loss and abatement of physiological function is correlated with degeneration. We have numerous instances among the pathogenic forms where greater luxuriance in growth is to be noted in connection with the mitigation of the powers of virulence as for instance in tuberculosis where cultivation on media containing glycerin-agar diminishes the virulence of the form while it increases the powers of growth. This can be explained as a case of partial reversion of the species, specialized in the direction of the pathogenic property to an ancestral saprophytic mode of existence.

The zymogenic, or fermentative function of bacteria has also been experimentally modified. The cultivation of the lactic acid bacillus, the germ causing the souring of milk, for a time in non-fermentable solutions, entirely destroys the property of decomposing the sugar in the milk and converting it into lactic acid. When grown continuously on solid media it likewise loses the power to peptonize or liquefy gelatin, a character of such importance that it is used as a basis for classification.

This variation of function is very marked in the case of some of the marine bacteria.

One Mediterranean species, *Bac. halophilus*, grows only with the greatest difficulty on media that contains less than the normal percentage of salt in sea water, while on media made with sea water it thrives luxuriantly. Constant cultivation however on ordinary media finally so changed its habits that in the course of twenty generations, it flourished as vigorously when supplied with fresh as with salt water.

Another case has recently come under my notice that presents even a more marked change. *Cladothrix intricata*, a common form in the Mediterranean mud was first isolated some 18 months ago. It then manifested no particular preference as to the amount of salt necessary for development, growing equally well on fresh as on salt water media. Since its isolation, it has been kept in stock on agar made with distilled or tap water. This season when an attempt was made to transfer it again to sea water media, it failed to grow. At first, I thought the original stock culture dead, but examining it microscopically I found that all vegetative forms had died, leaving innumerable spores. Seeding an ordinary agar tube from this spore-bearing stock, within 24 hours a copious characteristic growth of the germ was obtained. A second attempt to transfer the germ from the fresh culture, containing only *vegetative* forms was equally unsuccessful. In this instance, not only had the organism lost the ability to germinate when supplied with salt water food but even the vegetating bacilli died when introduced into this medium. This might not be surprising in ordinary terrestrial or fresh water saprophytes, but in a form originally a marine species, it shows a marked modification of nutritive conditions.

Examples like the above indicate that physiological and morphological modifications are so closely related to the environment of the species that it seems almost impossible to avoid the inference that there is some direct connection between them. Our ability to so rigidly govern the experimental conditions makes the case much stronger for these conclusions, than in those cases where the variations occur spontaneously. Whatever may be the true cause, or causes, that lead to variation among species, it cannot be denied that experiments from all classes of organic life will be valuable in adding to the store of observed facts, and thus giving us a broader basis upon which more accurate generalizations can be made. The evidence already at hand from the realm of the bacteria is promising enough to lead to the conviction that continued experimental work with reference to the problems of variation will be fruitful in results.

Few problems in biology are more prominent in the discussions of to-day than those pertaining to the subject of heredity. Among the different phases of this subject none hold a more important place than the doctrine of the transmission of acquired characters. The difficulties of the question are largely increased by our inability to define exactly what is meant by an acquired character. Under ordinary conditions, it is not easy to sharply differentiate between a variation brought about by an inherent tendency of the organism to vary, and one that is impressed upon the organism from without. We have however in the phenomena of artificial immunity, whereby a susceptible animal is rendered refractory toward a specific disease germ, a favorable field for the study of this problem. Artificial immunity is *par excellence* an acquired characteristic, as it is a deep seated and permanent change in the constitution of the animal that is produced through the influence of an exterior force. Several instances are on record that claim the transmission of acquired immunity in animals from the parent to the young. Chauveau found that the artificial immunity conferred upon goats was transmitted to their progeny but these cases are not pertinent to the problem of the transmission of an acquired character, for the possibility of a direct transference of the immunity by means of the body fluids is not excluded. All cases of the so-called transmission of artificial immunity that are conferred upon pregnant animals are open to the same objection. That the immunizing substance does permeate the entire body so that even the secretions are affected has been recently proven by the experiments of Ehrlich. He has recently shown that young mice may acquire immunity against that toxic alkaloid, ricin, by being nourished upon the milk of their mother, which has been artificially immunized. He obtained similar results with the tetanus bacillus, by immunizing a mother mouse with serum from a horse when the young were 17 days old. In 24 hours, one of the suckling young was infected with virulent tetanus spores from which it experienced no ill effect, while a control died in 26 hours. Two and three days after the mother had been immunized, other of the young were also tested, and it was found in these cases that the immunity was also transmitted from the mother to her progeny.

If the injection of the immunizing substance into the body of an animal can so permeate the tissues as to reappear in the secretions in 24 hours, it would seem highly probable that the immunity claimed to be transmitted by inheritance might be regarded as passing directly from the mother to her young rather than by means of the germ plasm.

The same objection applies to those cases where infectious diseases are claimed to have been transmitted. Wolff has recently subjected all of these cases to the closest examination, and he finds that only in a very limited number is there any probability that infection is ever transmitted from parent to progeny. In numerous cases of so-called inherited disease, he has actually determined lesions of the placenta, that allowed a direct passage of the germ. He claims that in no case has it been thoroughly proven that disease has been transmitted by the germ-plasm, although it is possible that either male or female generative cell may be diseased, and thus an infection, which he calls *conceptional* may take place.

Ehrlich has recently made some very interesting observations that have a direct bearing upon this question of acquired characters. They possess the advantage of approaching the subject in a fundamental manner, and while they are not numerous enough to justify general conclusions, they are of great interest as indicating what may be expected from a further study of this subject.

In this case, he experimented with ricin and abrin, those toxic vegetable alkaloids that are so closely related to the poisonous products of bacterial growth. The question at issue in his experiment was, whether the male or the female cell, if either, possessed the ability to transmit artificial immunity to its progeny. His methods were, to first pair a highly immunized male rabbit with a normal susceptible female, and determine whether the progeny possessed any immunity against the toxic substance. In this series of experiments, he found that the descendants invariably succumbed when inoculated with the ordinary fatal dose. From this it is evident, he says, " that the idioplasm of the sperm is not in condition to transmit acquired immunity."[2] He then took up the more complex problem of the inheritance of maternal immunity. The problem in this case is more difficult because we cannot tell with certainty whether the immunizing substance passes to the fœtus by the way of the germ plasm, or directly through the fœtal membranes. This difficulty is partially obviated if the immunity is conferred before fertilization of the egg occurs. But here another disturbing factor arises and that is to confer a permanent immunity for extended periods of time. Repeated tests with these alkaloids demonstrated the permancy of the immunity as very marked in this case, so that they were well suited for experiment on this question. He instituted another series of experiments on rabbits, by pairing an immunized mother with a male of normal susceptibility. Here he found a well pronounced immunity conferred upon the progeny for a certain length of time. At the age of three or four weeks, the young were able to stand ten times the dose that was ordinarily fatal, but in a month and a half it had almost entirely disappeared, and in three months the animal yielded readily to the injection of the normal lethal dose. No permanent immunity was therefore conferred by the mother.

---

[2] Since this was written, Tizzoni and Centanni have published (Cent. für Bakteriologie, Bd. XIII, No. 3.) the results of a similar series of investigations with rabbits on hydrophobia in which they arrive at a contrary conclusion. Their results are however not uniform but they are of interest in this connectiom as showing how important this field is from an experimental standpoint.

The temporary immunity can be explained on the assumption of the direct transmission of the anti-toxic substance to the young. He continued the test by pairing animals that were descendants from the progeny of immunized ancestors, but in no case were the descendants refractory toward the toxic substance. These results, although not conclusive upon the disputed question because not continued for a sufficient number of generations, are extremely interesting and go to show that the field of bacterial science offers wide and valuable opportunities for lines of investigation upon problems that have a general biological bearing.

Allusion has been made, and this in only the most cursory manner, to some of the more salient lines of work, and it requires no prophetic vision to see that an experimental field which is so suggestive in its infancy as this has proven to be, must in the future yield a rich harvest to patient systematic investigation.

THE COLOR VARIATIONS OF THE MILK SNAKE.

BY E. D. COPE.

The Milk Snake, *Ophibolus doliatus* Linn., ranges in North America over the Eastern, Central and Austroriparian districts, and is absent from the Sonoran and Pacific districts. It is found also in the humid regions of Mexico and Central America, as far as the Isthmus of Darien. Beyond this point it does not occur, but a very similar snake (*Opheomorphus mimus*) is found in New Grenada.

I have called attention to the color variations of this species in a brief paragraph in the introduction to my check list of Batrachia and Reptilia of North America, 1875[1] and have given the characters of the color types, or subspecies, in an analytical key, in a Review of the Characters and Variations of the Snakes of North America, 1892.[2] It is only now possible to give a series of figures representing the North American color forms; a possibility for which I am indebted to the U. S. National Museum. Both Jan and Bocourt have given admirable figures of some of these, but they have thoroughly confused the nomenclature.[3]

The variations of this species are instructive as illustrations of the law of variation, in view of the question raised by the Neodarwinian school as to its promiscuous or definite character. Are variations multifarious or promiscuous as alleged by that school, or do they display a serial passage from a point of departure to a definite goal, as alleged by the Neolamarckians? Researches into the color forms of insects, as those by Eimer in Lepidoptera,[4] and Horn in Coleoptera[5] point to definite series of stages, and my own examination into the color patterns of the varieties of the lizard *Cnemidophorus tessellatus* and *C. guttatus*,[6] and those of Eimer on *Lacerta muralis*,[7] show distinctly the same phenomenon.

---

[1] Bulletin of U. S. National Museum, No. I, p. 4.

[2] Proceedings of the U. S. National Museum, XIV, p. 589–608.

[3] See memoir quoted at [2] for my synonymy.

[4] D. Artbildung u. Verwandschaft bei Schmetterlinge, Jena, G. Fischer, 1889.

[5] Proceedings of the American Entomological Soc.

Before going further into the patterns of the *Ophibolus doliatus*, I give a synoptic key of them.

I. No yellow band posteriorly from orbit (a yellow half collar).

a. Dorsal spots or saddles (red) open at the side, their adjacent borders forming pairs of black rings.

Interspaces between red saddles open below; scales not black-tipped; front more or less black; first black ring on nape only *O. d. coccineus.*

Interspaces between red saddles closed by black spot below; scales black tipped; front black; first black ring complete. *O. d. polyzonus.*

Interspaces not closed; rings including first complete on belly; first yellow band crossing occipital plates; front black; scales not black-tipped *O. d. conjunctus.*

aa. Dorsal saddle spots closed at the sides below.

b. Saddles closed by a single black tract on the middle of the belly; no spots between the saddles.

Dorsal spots undivided medially; front black; first black ring complete *O. d. annulatus.*

Dorsal spots divided longitudinally by a median black connection; front black *O. d. gentilis.*

bb. Inferior borders of saddles separate and not confluent with each other.

Saddles completed on gastrosteges; no alternating spots; no black collar *O. d. parallelus.*

Saddles completed on gastrosteges; spots opposite intervals forming a single series on the middle line of the belly *O. d. syspilus.*

Saddles completed above the gastrosteges; alternating spots which do not meet on the middle line of the belly *O. d. doliatus.*

---

[6] Transac. Amer. Philos. Soc., 1892, p. 27.

[7] Archives f. Naturgischichte, 1881.

II. A yellow band posteriorly from orbit, bounded below by a black or brown one.

a. Saddle spots closed laterally on gastrosteges; alternate spots entirely on gastrosteges.

A half collar behind parietal plates, no superciliary stripe *O. d. temporalis.*

aa. Saddle spots closed above gastrosteges; alternate spots on scales.

A half collar nearly or quite touching occipital plates, no bands; alternate spots largely on gastrosteges *O. d. collaris.*

Neck with longitudinal bands; alternate spots largely on gastrosteges *O. d. clericus.*

Neck with bands; alternate spots entirely on scales *O. d. triangulus.*

In figure 1 are represented vertical, lateral and inferior views of parts of the body of the subspecies *triangulus*, taken from a specimen in my collection from West Chester Co., New York, which I owe to the kindness of my friend Mr. T. H Mead.

The characters of this form are seen in (1) the presence of a light band extending from the posterior angle of the eye downward and backward, which is bounded by a black border above and below; (2) a black cross-band on the posterior border of the prefrontal plates; (3) chevron shaped mark with the apex on the posterior part of the frontal plate, whose limbs extend posteriorly as a band on each side of the neck, where they are fused together, and continue as a single, broad band for a short distance; (4) a series of lateral spots which do not extend beyond the scales on to the gastrosteges, and which alternate with the dorsal spots; (5) a series of spots on the ends of the gastrosteges which alternate with the last mentioned; (6) a series of spots on the centers of the gastrosteges which alternate with the spots mentioned under (5). The ground color in this form is gray, and the spots are a rich brown with black borders. The belly has a white ground color.

In fig. 2 we have the subspecies *clericus*, where the following modifications appear. The fusion of the limbs of the chevron is more complete, and the dorsal spots are more expanded transversely. They extend to within two or three scales of the gastrosteges, while in the form *triangulus* they are five scales distant. The alternate spots touch the gastrosteges. This figure is taken from a specimen in the Museum of the Philadelphia Academy from southern Illinois.

In fig. 3 we have an individual from Elmira, Illinois, which illustrates the characters of the form *collaris*. Here the chevrons are distinct from the first dorsal spot, whose anterior black border forms a half collar on the neck. This specimen is instructive, as it displays the last connection between the chevron and the first spot, in a black line on each side. This is wanting in the typical form.

The collar of ground color is complete in its anterior border as well as the posterior in the form *temporalis* (fig. 4), owing to the disappearance of the chevron. The transverse band on the prefrontals has also disappeared. The anterior extremity of the postorbital stripe is cut off, and consists of a spot of ground color. The dorsal saddle spots are wider, reaching the gastrosteges, while the intermediate spots are exclusively gastrostegal. The spots which alternate with them, have fused on the middle line. Fig. 4 is from a specimen from the State of Delaware.

In subspecies *doliatus* the postocular stripe has disappeared, and the chevron is replaced by a black patch on the parietal and temporal plates. In other respects this form is more like the form *collaris*. The dorsal saddle spots are separated by a row or two of scales from the gastrosteges, and their alternating spots are partly on the scales. The ground color in this form, as in the *temporalis*, approaches red. This is the form of the tier of states between latitude 40° and the Gulf States.

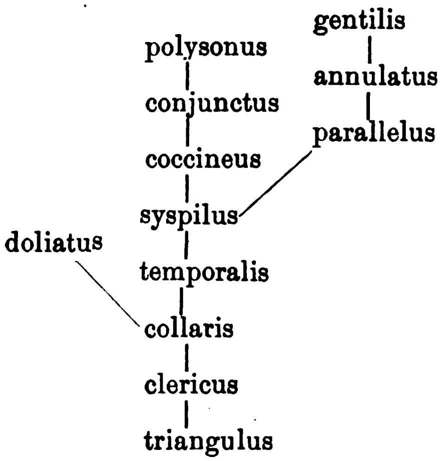
The subspecies *syspilus* is represented in fig. 7. The head pattern is like that of *doliatus* with the black patch more or less reduced—in the specimen figured being represented by a cross stripe. The dorsal saddle spots are more expanded than in any form yet encountered, their lateral borders being completed below the scales and entirely on the gastrosteges. The alternate spots now meet and fuse on the middle line of the abdomen, and the second series of alternating spots has disappeared. This is distinctively a southern form, extending west to central Oklahoma.

The dorsal saddles are so far extended in the next subspecies, *parallelus*, as to form two parallel stripes with a narrow strip of ground color between, on the middle line of the abdomen. The alternating spots have disappeared. In the specimen figured, which is from Florida, and is in the U. S. National Museum, the supraocular spots seen in *temporalis*, are indicated. The ground color is red. Black begins to appear on the head.

From the form *syspilus* two types of color modification may be traced. One of these brings the borders of the saddle spots together on the median line, forming a median black stripe; this is the subspecies *annulatus*, which belongs to western Texas and the adjacent parts of Mexico. The top of the head is black (fig. 9). In the other, the lateral borders of the saddle spots have disappeared altogether, so that the body is more or less completely encircled by pairs of black rings, the alternating spots having disappeared. This might be supposed to have resulted from a continuation of the process by which the alternating spots have disappeared, and the edges of the saddles been brought closer and closer together. The continued transverse extension of the spot color would finally obliterate the lateral borders completely, as actually occurs in this last form, the *coccineus* of authors, which is the common type of the Gulf Coast. But the black has not covered the head and muzzle of this form as in the *annulatus*. These regions are on the contrary red, as is the spot color generally, while the ground color is pale yellow.

A tendency to a development of black pigment in the saddle spots is seen in two other forms. The subspecies *gentilis* resembles *annulatus*, but has a black longitudinal dorsal band which divides each saddle spot in two equal halves. This is a rare form, only known from the Indian Territory. The common Mexican form (*polyzonus*) has the paired rings of *coccineus*, the black head of *annulatus*, but each scale of the red intervals is tipped with black.

The relations of these forms may be expressed in a tabular form as follows:



The main series corresponds with a distribution in latitude, commencing with the *triangulus* of New England and New York, and passing gradually to the *coccineus* of the Gulf coast regions, and *polyzonus* of Mexico and Central America. The forms of the right hand column are (except the parallelus), from the central warmer parts of the continent. I think this series of color forms of the *Ophibulus doliatus* demonstrates three points. First; the series is determinate and not indeterminate. Second; the patterns have relation to latitude; the tendency being to make the spot color of the upper regions red, and to extend the area of this color more and more, as we proceed southwards. Third; so far as regards eastern North America, there is a diminution of size in passing from north to south; the *O. d. coccineus* being the smallest of the subspecies. In Mexico, the size is recovered, as the *O. d. polyzonus* equals in dimensions the *O. d. triangulus.*

EDITORIALS.

—DURING the past few years several institutions of higher education in the United States have begun the publication of the results of work done in their laboratories and seminars. Some regard this new departure with favor, while in the opinion of others it is a matter of regret. Of the aspects as related to Natural History alone we need to speak. The arguments against such publications are weighty. The literature on the subject is enormous; no less than 20,000 pages are required to contain the annual contributions of the world to zoology alone; and every new periodical adds just so much to the difficulty of keeping en rapport with the subject. Again with the multiplicity of periodicals there is a corresponding deterioration on the part of some in the quality of the matter published. With fewer chances for appearing in print the law of natural selection would weed out many a mediocre production.

On the other hand, these new journals have their strong points. America is lacking in facilities for the prompt publication of results. All of our publishing scientific societies are overwhelmed with papers, while our independent journals devoted to research are utterly inadequate to present more than a fraction of the papers of the better class. Combination between institutions to support new journals of the better class is apparently out of the question, while the persons who, like Professor Whitman and Mr. Allis, are willing to pay the deficit of a journal from their own pockets are lamentably few. To conduct investigations with no chance for the publication of the results obtained is discouraging. But since it is only by research that we can ever advance, every aid or encouragement to investigation should be welcomed. We can only hope that the editors of these new journals will exercise due critical care and that they will see to it that every paper published is an actual contribution to knowledge.

. . . .

The bill recently introduced into the House of Representatives by Congressman Cogswell, appropriating 100,000 dollars for the extermination of the Gypsy Moth in Massachusetts seems to us pernicious. It is, if voted, sure to prove a precedent for further expenditures for the same purpose, for an unlimited term of years. The extermination of this pest is far from an easy task and for several years the State of Massachusetts has been sending good money after bad in its attempt to accomplish the impossible task. Suppose for a moment that the various commissions were able to kill every moth except one pregnant female, and were then to rest from their labors. In a few years matters would be as bad as before. The Massachusetts commission have had nothing like such success. Their workmen have undoubtedly killed large numbers of these insects but each year shows the moth in a larger territory than it occupied the year before and extermination is no nearer than it was a dozen years ago. We do not wish to be understood as saying that the Gypsy Moth commission has done no good. It has checked the depredations as it can undoubtedly check them in the future. But this means, if the present methods are continued, a continual drain upon the treasury of the commonwealth which will only cease with that millennium which shall work a change in the morals of insects as well as of man.

In its future work the commission should employ as its head a trained entomologist who should devote his time, not to the hunting of Gypsy Moths in trees, hedge rows and garden patches, but in finding and introducing some natural enemy as has been so successfully done in the case of the Orange Vedalia in California. Moths, eggs, larvæ and cocoons will escape the most careful of field agents, but insect parasites will keep the pest in continual check and render the employment of an army of expensive workmen unnecessary.—K.

The numbers of the American Naturalist for the year 1893 were issued at the following dates, January, Jan. 11th ; February, Feb. 4th ; March March 8th ; April, April 5th ; May, May 25 ; June, June 15th ; July, July 24th ; August, Aug. 25th; September, Sept. 30th ; October, Oct. 31st ; November, Nov. 24th, December, Dec, 13th.

RECENT BOOKS AND PAMPHLETS.

Allen, J. A.—On a Collection of Birds from Chapada, Matto Grosso, Brazil, made by Mr. H. H. Smith, Part III, Pipridae to Rheidae.

——List of Mammals and Birds collected in Northeastern Sonora and Northwestern Chihuahua, Mexico, on the Lumholtz Archeological Expedition, 1890–92. Extrs. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

Annual Report of the Yorkshire Philosophical Society for 1892. From the Society.

Bailey, V.—The Prairie Ground Squirrels or Spermophiles of the Mississippi Valley. Bull. No. 4, U. S. Dept. Agri. Div. Ornith. and Mam. From the Department.

Baldwin, S. P.—Recent Changes in the Muir Glacier. Extr. Am. Geol., 1893. From the author.

Barlow, A. E.—Relations of the Laurentian and Huronian Rocks North of Lake Huron. Bull. Geol. Soc. Am., 1893. From the Society.

Becker, G. F.—Quicksilver Ore Deposits with Statistical Tables. Extr. Mineral Resources of the United States, Calendar Year, 1892. Washington, 1893. From the Geol. Surv.

Boettger, O.—Reptilien und Batrachier aus Venezuela. Sonderabdruck aus Ber. Senck. Naturf. Gesell. Frankfort a. M., 1893. From the author.

Bridge, T. W. **and** A. C. **Haddon**.—The Air-Bladder and Weberian Ossicles in the Siluroid Fishes. Extr. Phil. Trans. Roy. Soc. London, Vol. CLXXXIV, 1893. From the authors.

Bulletin No. 47, Massachusetts State Agric. Exp. Station, May, 1893.

Bulletin Scientifique de la France et de la Belgique, publié par M. Giard. T. XXIV, 1892. From M. Giard.

Bulletin of the United States Fish Commission, Vol. X, for 1890, Washington, 1892. From the Fish Commission.

Burmeister, G.—Anales del Museo Nacional de Buenos Aires para dar á conocer los objectos de Historia Natural nuevos o poco conocidos conservados en este establecimiento. Buenos Aires, 1891. From the Museum.

Chalmers, R.—Height of the Bay of Fundy Coast in the Glacial Period relative to sea-level, as evidenced by Marine Fossils in the Bowlder clay at Saint John, New Brunswick. Extr. Bull. Geol. Soc. Am., 1893. From the Society.

Claypole, E. W.—The Cladodont Sharks of the Cleveland Shale. Extr. Am. Geol., Vol. XI, 1893. From the author.

Clevenger, S. V.—Illinois State Hospital Notes. Extr. The Times and Register, 1893. From the author.

Discursos Leidos ante la Real Academica de Ciencias exactas, fisicas y naturales en la Recepcion publica del Ilmo. Sr. D. Justo. Egozcue y Cia el dia 14 de Mayo de 1893. Madrid, 1893.

Ells, R. W.—The Laurentian of the Ottawa District. Extr. Bull. Geol. Soc. Am., 1893. From the Society.

Faxon, W.—Preliminary Descriptions of New Species of Crustacea. Extr. Bull. Harv. Mus. Comp. Zool., Vol. XXIV, 1893. From Alexander Agassiz.

First Annual Report of the Museum of the Illinois Wesleyan University, Bloomington, Ill., 1893. From the Museum.

FORBES, S. A.—A Preliminary Report on the Aquatic Invertebrate Fauna of the Yellowstone National Park, Wyoming, and of the Flathead Region of Montana. Extr. Bull. U. S. Fish Commission for 1891; date of pub., 1893. From the Illinois State Laboratory of Natural History.

GULDBERG, G.—Zur Kenntniss des Nordkapers. Abdruck aus den Zool. Jahrb. Siebenter Bd. From the author.

HOFFMAN, H. A. AND D. S. JORDAN.—A Catalogue of the Fishes of Greece, with Notes on the Names now in use and those employed by classical authors. Extr. Proceeds. Phila. Acad., 1892. From the authors.

HILL, R. T.—The Invertebrate Paleontology of the Trinity Division, Extr. Proceeds. Biol. Soc. Wash., June 3, 1893. From the author.

HULKE, J. W.—On the Shoulder Girdle in Ichthyosauria and Sauropterygia. Etxr. Proceeds. Roy. Soc., Vol. LII. From the author.

KEYES, C. R.—Some Maryland Granites and Their Origin.——Epidote as a Primary Component of Eruptive Rocks. Extr. Bull. Geol. Soc. Am., 1893. From the Society.

LECHE, WM.—Ueber die Saugethiergattung Galeopithecus. Separatabdruck aus den Zoolgischen Jahrb. Zeits. für Syst. Geog. und Biolog. der Thiere. Zweiter Band. No date given. From the author.

LESQUEREUX, LEO.—The Flora of the Dakota Group. Monograph of the U. S. Geol. Surv., Vol. XVII. Washington, 1892. Edited by F. H. Knowlton. From the U. S. Geol. Surv.

LEVERETT, F.—The Glacial Succession in Ohio. Extr. Journ. Geol., Vol. I, 1893. From the author.

LINDGREN, W.—Two Neocene Rivers of California. Extr. Bull. Geol. Soc. Am., 1893. From the Society.

LOPER, S. W.—A New Fossil Fish, *Ischypterus newberryi*. Extr. Pop. Sci. News, 1893. From the author.

MACFARLANE, J. M.—A Comparison of the Minute Structure of Plant Hybrids with that of their Parents, and its Bearing on Biological Problems. Extr. Trans. Roy. Soc. Edinburgh, 1892. From the author.

MCGEE, W J—The Columbian Formation. Extr. Proceeds. Am. Ass. Adv. Sci., Vol. XXPVI. From the author.

MERRIAM, C. H.—Rediscovery of the Mexican Kangaroo Rat (*Dipodomys phillipsii* Gray), with field notes by E. W. Nelson. Extr. Proceeds. Biol. Soc. Washington, Vol. VIII, 1893. From the author.

MILLER, G. S.—Notes on *Thomomys bulbivorus*.

——Description of a New White-Footed Mouse from the Eastern United States. Extrs. Proceeds. Biol. Soc. Washington, 1893. From the author.

EISEN, G.—Anatomical Studies on New Species of Ocnerodrilus——On the Anatomical Structures of Two Species of Kerria. Extrs. Proceeds. Cal. Acad. Sci., Ser. 2, Vol. III, 1893. From the author.

MOCQUARD, M.—Sur l' existence d' une poche axillaire chez certains Caméléons. Extr. Compte-rendu Sommaire Soc. Philomath. Paris, 1893. From the author.

Monthly Report, May, 1893, Maryland State Weather Service. From the Dept. Agric.

Newton, A. and H. Gadow.—A Dictionary of Birds. Part I (A-Ga) London, 1893. From the author.

Packard, A. S.—The Life Histories of Certain Moths of the Families Ceratocampidae, Hemileucidae, etc., with Notes on the Armature of the Larvae. Extr. Proceeds. Am. Philos. Soc., 1893. A New Genus and Two New Species of Limacodes-like Moths. Extr. Entomol. News, 1893. From the author.

Powell, J. W.—Seventh Annual Report of the Bureau of Ethnology, 1885–86. Washington, 1891. From the Smithsonian Institution.

——Eleventh Annual Report of the Director of the U. S. Geol. Surv. for 1889–90. Part II, Irrigation. From the Survey.

Pope, A. A.—Errors in School-Books. Boston, 1893. From the author.

Rauff, H.—Paleospongiologie. Paleontographica, Erster Teil, Viérzigster Band. Stuttgart, 1893. From K. A. v. Zittel.

Retzius, G.—Das Nervensystem der Lumbricinen. Separatabdruck aus Biol. Untersuchungen von Dr. G. Retzius. Neue Folge III and IV. I. Stockholm, 1892. From the author.

Riggs, I. R.—A Dakota-English Dictionary. Contributions to North American Ethnology, Vol. VIII. Washington, 1890. From the U. S. Geol. Surv.

Sarasin, P. und Dr. F. Sarasin.—Ergebnisse naturwissenchaftlicher Forschungen auf Ceylon. Zweiter Band. Zur Entwicklungsgeschicte und Anatomie der ceylonesischen Blindwühle *Ichthyophis glutinosus*, L. Weisbaden, 1887–1890.

Scudder, S. H.—The Life of a Butterfly. A Chapter in Natural History for the General Reader. New York, 1893. From Henry Holt & Co., Pub.

——The Orthoptera of the Galapagos Islands. Extr. Bull. Harv. Mus. Comp. Zool., Vol. XXV, 1893. From Alexander Agassiz.

Seeley, H. G.—On *Omosaurus phillipsi* (Seeley). Extr. Report Yorkshire Philosoph. Soc., 1892. From the author.

Siebenrock, F.—Das Skelet von *Brookesia superciliaris* Kuhl. Aus den Sitzungsb. der kaiserl. Akad. Wissensch. in Wien, Mathem-naturw. Classe, 1893. From the author.

Smith, W. H. C.—The Archean Rocks West of Lake Superior. Bull. Geol. Soc. Am., 1893. From the Society.

Stevenson, J. J.—Sketch of the Life of Prof. John Strong Newberry. Extr. Am. Nat., Vol. XII, 1893. From the author.

Storms, R.—Sur le Cybium (Euchodus) bleekerii du Terrain Bruxellien. Extr. Bull. Soc. Belge de Geol. de Paleontol., et d'Hydrol. Tome VI, 1892. From the author.

RECENT LITERATURE.

Piersol's Histology.[1]—This text-book requires more than a passing notice. The four hundred illustrations, with the exception of a little over ten per cent. of them, are from original drawings by the author, and give to the book an air of originality that is refreshing.

This book is the only American Manual of histology that has yet been published that meets the requirements of modern methods of teaching. It is not overburdened with accounts of methods and descriptions of laboratory appliances, too numerous to be brought into an elementary course. About twenty pages at the close of the volume, are given up to the discussion of the best standard method of fixing, mounting, staining and embedding, that are used in histology, without giving a bewildering lot of detail that is more calculated to appal than to inform the beginner.

This course seems to the writer a rational one, and is a feature that will especially commend the book to students, who wish to get an actual working knowledge of histology.

The descriptive part is full, without being burdened with detail that is of no essential use to the beginner in acquiring an elementary knowledge of the subject. The important tissue-structures and relations of tissues, are indicated in the text with heavy-faced type, so that the student has before him the important points indicated to him by catch-words.

Without pretending to be a treatise on embryology, the subject of the development of the tissues and tissue-elements is dealt with fully enough for the purposes of a text-book especially intended for medical students. The original figures are derived very largely from preparations made from the human subject and the book, therefore, has an added value, from the fact that it is a new contribution to the iconography of the subject.

Sufficient attention is given to the most recent developments in cytology and in the histology of the nervous system, in both of which great recent advances have been made to bring it up to modern requirements. The volume is well gotten up and altogether reflects much credit upon the successor of Professor Leidy, who was, it may not be generally known, the editor and translator of one of the very earliest text-books published in America on the subject of histology. That the successive occupants of the chair of Anatomy in the University of Pennsylvania should have taken such an important share in fostering the development of histological study in America, should be a matter of pride to all who are interested in scientific and educational progress.—R.

---

[1] Text-book of Normal Histology, including an account of the development of the tissues and of the organs. By George A. Piersol, M. D., Professor of Anatomy, University of Pennsylvania. 8 vo, pp. 439, with 409 illustrations in the text. Philadelphia, J. B. Lippincott & Co., 1893.

First Annual Report for 1892, Iowa State Geological Survey.[1]—A quarto volume of 474 pages containing the administrative reports, and accompanying papers illustrated by a number of maps and sections, some of them colored, and a number of photo-gravures. Of these papers Mr. Charles Keys contributes three: (1) A summary of the present knowledge of the Geological formations of Iowa; (2) An Annotated Catalogue of Minerals; (3) A Bibliography of Iowa Geology arranged in the form of a dictionary catalogue. The remaining three embody the observations of Mr. S. W. Beyer on the Ancient Lava Flows in the Strata of Iowa, Mr. H. F. Bain's studies of the Distribution and Relations of the St. Louis Limestone in Mahaska County, Iowa, and notes on Niagara Lime-burning Dolomites and Dolomitic Building Stones of Iowa by G. L. Houser.

The Paleozoic Group of Georgia.[2]—Dr. J. W. Spencer's report on the work of the Geological Survey of Georgia is confined to a detailed statement of the geology and economic resources of the Paleozoic Group developed in the northwestern Counties of Georgia. Under the head of Geology, the author gives the general characters of the systems of this group as exemplified in the region under discussion, the recent formations and evolution of northwestern Georgia, the physical features of the country underlaid by Paleozoic rocks, and the local geology of the different countries embraced in the Paleozoic belt. Under Economic Resources the distribution and modes of occurrence, and the character of red and brown iron ores, manganese and aluminum ores, coals,building and paving materials, variability of soils, and water-powers of the country are set forth. In the closing chapter Dr. Spencer gives a bibliography of Georgia geology and a statement of the progress of the survey.

The report is illustrated by 10 plates, 34 cuts, and a geological map.

---

[1] Iowa Geol. Survey, Vol. I, First Annual Report for 1892, with Accompanying Papers, Des Moines, 1893.

[2] The Paleozoic Group. The Geology of Ten Counties of Northwestern Georgia and Resources. By J. W. Spencer, A. M., Ph. D. F. G. S. (L. and A.) Report of the Geographical Survey of Georgia, Atlanta, 1893.

The Mesozoic Echinodermata of the United States.[4]—This volume, Bulletin No 97 of the U. S. Geological Survey, is the first of a series of reports on American fossil Echinoderms prepared by Dr. William B. Clark. It comprises a systematic review of the Mesozoic Echinodermata of the U. S. in which descriptions of moderate length are accorded the different species; a complete bibliography of the subject; a table showing the geographical range of the American species; and catalogue of the specific names.

Fifty plates illustrate all the species accompany the report, and, according to the author they show many details of structure not recorded in the descriptive portion.

The Flora of the Dakota Group.[5]—This memoir in quarto form was in preparation by Prof. Lesquereux at the time of his death. It was, however, so nearly completed that it has been published with but slight changes from the original wording. The work is limited to the description of fossil plants represented by a large number of specimens obtained at different localities of the Dakota Group, especially in Kansas, and to the evidence derived from the character of the plants in regard to their origin, their relations, and their places in the history of the vegetation of the world.

The original manuscript embraced descriptions and figures of 350 species of plants, but before it could be published, extensive additional collections were made in Kansas. This new material was identified and described by Prof. Lesquereux, and incorporated in the monograph. It added 110 species to the list, making in all 460 species now known from the Dakota Group.

The drawings which accompany the work are life size and occupy 66 plates.

A short account of the life and work of Prof. Lesquereux is given by the Editor in his preface.

Fritsch's Fauna of the Gaskohle of Bohemia.[6]—The important fauna of the Permian formation receives further illustration from the parts of Dr. Fritsch's great work last issued. The first and second parts now under review are occupied with the Ichthyotomous Elasmobranchii, while the third contains the Acanthodian Elasmobranchs and the Teleostomi of the superorder Actinopterygia.

---

[4] Bulletin of the United States Geol. Surv., No. 97. The Mesozoic Echinodermata of the United States. By William Bullock Clark, Washington, 1893.

[5] Monographs of the U. S. Geol. Surv., Vol. XVII. The Flora of the Dakota Group. A Posthumous Work by Leo Lesquereux. Edited by F. H. Knowlton, Washington, 1892.

[6] Fauna der Gaskohle und Kalksteine der Permformations Böhmen's, von Anton Fritsch; Band II, H. 4, 1889 and Band III, Hefts 1 and 2, 1890, 1893. Prague.

The descriptions of Ichthyotomi cover several species which the author refers to three genera under the names Orthacanthus Agass. Pleuracanthus Agass. and Xenacanthus Goldfuss. The material at Dr Fritsch's disposal is excellent, and he elucidates thoroughly the structure of the fins of all these forms, and is able to identify the spines and teeth of the different species. We are enabled through the kindness of Dr. Fritsch to give a figure of the *Xenacanthus dechenii* from his work. Thanks to his labors the greater part of the skeleton of these remarkable forms is now well known. There remains some doubt whether the forms distinguished as different genera do not belong to a single genus, as the characters pointed out by Dr. Fritsch to be distinctive in the spines and teeth seem to be specific rather than generic, as has been already argued by Mr. Smith Woodward. If the divided terminal rays of the paired fins of *Xenacanthus dechenii* are not dermal, and only absent from the fins of the other forms by accident, as appears to be the case, then Xenacanthus must be regarded as a genus distinct from the other forms. Dr. Fritsch does not adopt the order Ichthyotomi, but his reasons for this course are not clear.

The subclass Teleostomi is adopted by Fritsch, who states that he does not regard the division of "Ganoidei" as well founded. In this he is in accord with views which I have advocated since 1871, in the face of almost universal opposition. I can only say that paleontologic discovery has long since demonstrated the correctness of this position, and its general acceptance cannot be long delayed. Fritsch remarks that Smith Woodward adopts my order of Ichthyotomi with a new definition, as though it were the division proposed by Cope. But he is evidently not aware that I redefined the order, on the basis of the discovery of the fin structure by Sauvage, in a synopsis of the Families of Vertebrata published in the AMERICAN NATURALIST for Oct., 1889, with which the later definition of Woodward in the Catalogue of Fishes of the British Museum (1891) nearly agrees.

The only form of Actinopterygian fish described, is the genus Trissolepis, which is referred to the Chondrostei. It possessed a raptorial dentition of acute teeth, and scales of both ctenoid, cycloid and ganoid forms, the last on the caudal region only. The following figure from Fritsch's work represents this interesting form.

Of Acanthodii, species of the genera Traquairia, Protacanthodes, and Acanthodes are described; the first two genera being new to science.

Machaeracanthus is also referred tothis order. The author accepts the reference of the Acanthodii to the Elasmobranchii.

Dr. Fritsch makes the important discovery of the scales of Ceratodus, which resemble those of the existing species.

The present work is the most important one of modern times in the amount of light which is thrown on the structure of the primitive fishes.—E. D. Cope.

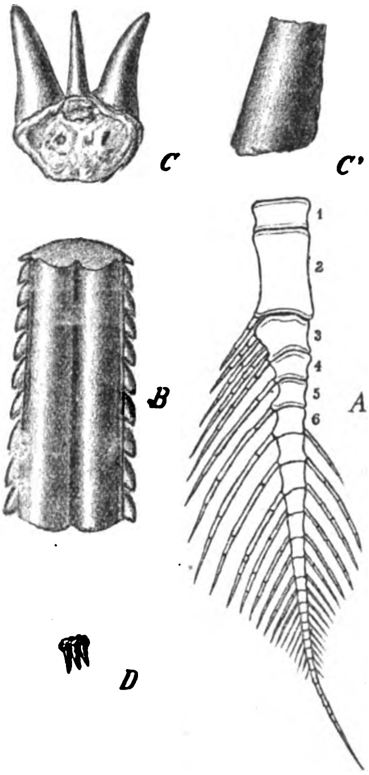


Fig. 1.—*A* Pectoral fin of Xenacanthus (Pleuracanthus). *B* Cephalic spine. *C* Tooth; *C'* Tooth magnified. *D* Gill prickles; all of Xenacanthus (Pleuracanthus).

Explanation of Plates.

Plate XXIX. *Xenacanthus dechenii* Goldf; from Fritsch.
Plate XXX. *Trissolepis kounoviensis* Fritsch; from Fritsch.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Mud Avalanches in the Mustagh Mountains.—During a recent exploration in the Mustagh Mountains in India, Mr. W. M. Conway noticed the accumulation in the valleys, of debris consisting of stones as often rounded as angular, embedded in mud. In the Gilgit valley this accumulation reaches a depth of 1000 feet or more. The author claims that the work of filling up the valleys, not only in the Mustagh Mountains but all the deeply filled valleys characteristic of the Central Asian plateau, has been done by mud avalanches, and he gives the following interesting account of one of which he was an eye witness.

" We were just approaching the mouth of a deep, narrow nala that crossed our path when we heard a noise as of continuous thunder, and beheld a vast black wave advancing down it at a rapid pace. Some accumulation of water had got loose high aloft, and the flood was bringing the hill down with it. When we reached the edge of the nala the main mass of the stuff had gone by and only a thick, black stream of mud was rushing swiftly past. This became by degrees more liquid until it was no longer mud but black water. We waited for some time till the waters subsided. At length Harkbir found a way across the torrent by leaping from stone to stone. We had begun to follow him when Karbir, who was looking up the nala, shouted to us to come back, which we did with the nimblest feet. We were not more than out of the ditch before another huge mud avalanche came sweeping down. It was a horrid sight. The weight of the mud carried huge masses of rock down the gully, rolling them over and over like so many pebbles, and they in turn dammed back the muddy torrent and kept it moving slowly with accumulating volume. Each of the big rocks that formed the vanguard of this avalanche weighed many tons; the largest were about 10 feet cubes. The stuff that followed them filled the nala to a width of about 40 feet and a depth of about 15 feet. The thing moved down at about the rate of five miles an hour. When the front of the avalanche was gone, and the mass of stuff became shallower, the mixture was about half mud, half rocks, and flowed faster. Now and again a bigger rock than the average would bar the way; the mud would pile up behind it and presently sweep it on. Looking up the nala we could see the sides of it constantly falling in and their ruins carried down. Three times did the nala yield a frightful offspring of this kind, and each time it found a new exit into the main river below, and entirely changed the shape of the fan. The third avalanche was the largest of all, and fortunately left a causeway of stones, reaching almost across the nala, at our very feet. Some big fall must have presently taken place higher up and dammed back the waters, for the stream ran almost dry and we were enabled to cross the gully without difficulty.

"Assuming that one of the avalanches we saw travelled at the rate of only 7 miles an hour=200 yards a minute, and took only 7 minutes to pass any point, it would be 1400 yards long. Call its average width 8 yards, and average depth 2 yards, it would consist of over 10000 cubic yards of stuff. Suppose three-fourths of this to have been water, you get 2500 cubic yards of débris discharged by one of these avalanches, and we saw three come down a single gully, where others had fallen before we arrived and others fell after we left. 15000 cubic yards is a low estimate for the fall of that one day down that single and relatively small gully. One gully of this sort to every mile of valley is a minimum computation. It is easy to see then what a powerful element mud avalanches must be in determining the physical features of this region of the earth." (Geog. Journ., Oct., 1893.)

Cladodont Sharks of the Cleveland Shale.—The fossil sharks recently discovered in the Cleveland shale are of especial interest and importance because they show definitely the form of structure of these early Elasmobranchs. Professor E. W. Claypole has made them the subject of a paper in the American Geologist, May, 1893. The material now at hand represents four species of *Cladodus*, and two of *Monocladodus*. These genera are closely allied, but the absence of lateral denticles, in the opinion of the author, marks a generic difference. *M. clarkii* is distinguished by the fact that the teeth stand in pairs, one close behind the other. *M. pinnatus* is represented by a single specimen which is unique from the great strength of the ventral fins, whence comes its specific name. Both of these species are figured, together with *Cladodus sinuatus*, *C. clarkii*, and *C. rivi-petrosi*. Professor Claypole gives also an amended description of Newberry's *C. replerii*. The genus *Monocladodus* is very near to, if not identical with *Styptobasis* Cope.

The Neocene Sierra Nevada.—The observations recorded by Mr. Waldemar Lindgren in a paper on Two Neocene rivers of California appear to prove conclusively (1) that the Sierra Nevada in Neocene times, in the watersheds of the Yuba and American rivers, formed a mountain range as distinct as that of to-day, and that its first summit in general, coincided with the corresponding modern divide; (2) that the slope of this range has been considerably increased since the time when the Neocene ante-volcanic rivers flowed over its surface; (3) that the surface of the Sierra Nevada has been deformed during this uplift, and that the most noticeable deformation has been caused by a subsidence of the portion adjoining the great valley relatively to the middle part of the range. (Bull. Geol. Soc. Am., June, 1893.)

Geological News. Paleozoic.—In Notes on some Devonian plants from New York and Pennsylvania, Mr. Penhallow describes a new species, which he refers to the genera *Haliserites, Dictyotites* (gen. nov.) and *Psilophyton.* From the data afforded by these plants the author gives a fresh definition of the characters which distinguish *Haliserites* and reintroduces the *Dictyotites*, once used by Brongniart, but which had been abandoned by authors. (Proceeds. U. S. Natl. Mas., Vol. XVI, 1893.)

Mr. C. S. Prosser calls the attention of geologists to lists of fossils from eastern New York and Pennsylvania, with statements of their stratigraphic position, which show that the fossiliferous zone underlying the Oneonta sandstone in Chenango and Otsego counties, New York, is not the top of the Hamilton but belongs to the Portage stage. (Proceeds. U. S. Natl. Mus., Vol. XVI, 1893.)

A new fossil sponge has been found in the shales of the Quebec group at Little Metis, Canada. It was probably of sac-like form and about 14 inches in diameter. Its walls consist of rhombic meshes made up of delicate spicules loosely twisted together and apparently branching at the angles. This sponge is the largest and most complex yet found in formations of so great age. Dr. Hinde proposes to place it in the new genus, *Palæsaccus.* (Bull. Geol. Soc. Am., Sept., 1893.)

Mesozoic.—In a contribution to the invertebrate paleontology of the Texas Cretaceous Mr. F. W. Cragin describes 151 species, of which 1 Cœlenterate, 17 Echinoderms, and 86 Molluscs are either new species or varieties. This collection belongs to the Museum of the Texas Geol. Surv. and comprises the Cretaceous fossils accumulated during the field work of four years. (Fourth Ann. Rept., Texas Geol. Surv. for 1892.)

The recent figures and descriptions of European Pterodactyls published by Professor Seeley have satisfied Mr. S. W. Williston that the generic characters of Pteranodon Marsh are included in those of Ornithostoma Seeley, and he accordingly states that the Kansas species hitherto placed in the genus Pteranodon may now be known under the earlier generic name of Ornithostoma, and the family as the Ornithostomatidæ. (Kansas Univ. Quart., Oct., 1893). In this same publication Mr. Williston gives a life size restoration of *Clidastes velox* Marsh based upon an unusually complete specimen of this Mosasaur from western Kansas.

Two new species of invertebrates *Ostrea munsonii* and *Radiolites davidsonii,* from the Caprina limestone of Texas are figured and described by Mr. R. T. Hill. In a preface to the descriptions the author states that this formation is of great interest from the fact that in it we have all the species of the aberrant Chamidæ and Rudistes known to occur in the United States, with the exception of Coralliochama of California and the *Radiolites austinensis,* forms common in the Upper Cretaceous of Alabama, Texas and Colorado. (Proceeds. Biol. Soc. Wash., 1893.)

Mr. W. M. Fontaine's examination of the collection of fossil plants from the Trinity division of the Comanche series of Texas results as follows: Equisetum, 1 sp. nov.; Ferns 1: Cycads 7, of which 1 is new; Conifers 10, 4 new, uncertain 4, of which 3 are probably new. The author considers the plant bearing portion of the Trinity to be somewhat older than the basal Potomac strata, but the difference in age is not great. (Proceeds. U. S. Natl. Mus., 1893.)

A small collection of fossil plants from the Kootanie group of Great Falls, Montana, has been examined by Mr. Fontaine. The specimens show nothing but ferns, conifers and one Equisetum. The conifers are badly preserved. Of the 9 ferns 5 are new, descriptions of which are given in the Proceeds. U. S. Natl. Mus., Vol. XV with plates. Cycads are rare in the Great Falls flora, none being found in the collection examined. The one figured in the paper mentioned under the name *Zamites montanensis,* was obtained from this field by Mr. Williams, and is described by Mr. Fontaine from a drawing. This collection confirms Dr. Newberry's conclusions that the Potomac group, the Great Falls group, the Kootanie group of Canada, and the Kome group of Greenland are all of the same general age.

Cenozoic.—In studying the Finger Lakes of Western New York, Mr. A. P. Brigham concludes that the basins are a composite resultant of valley erosion, glacial scoop, and drift barriers, with perhaps a slight element of orography. The deepening of the lakes to the southward is the result of the narrowing of the ice between contracting valley walls which increases the vertical pressure and hence intensifies the erosion. (Bull. Am. Geog. Soc., 1893.)

In a review of the knowledge of the paleolithic man in North America M. Boule remarks that the recent work of Mr. Holmes does not invalidate the discoveries of paleolithic objects in America, and particularly those of Dr. Abbott, which M. Boule considers to be "true finds" in every sense of the word.

It is suggested by Mr. F. W. Hutton that the Ostriches of Africa and South America have orginated in the Northern Hemisphere possibly as swimming birds—and the Gastornithidæ, which have relations with the Anatidæ, may be their ancestors. (Proceeds. Austral. Assoc. Adv. Sci., 1892.)

According to Dr. Du Riche Preller, the Engadine Lakes owe their origin to the subsidence or dislocation of the old divide of the Inn and Bargalia systems, and the consequent deflections to the south of the original Inn sources. From a powerful Alpine torrent the Inn was reduced to a small stream without sufficient volume or fall to carry away the deposits brought down by lateral torrents. These deposits accumulated and thus the lakes were formed by the weakened river being banked up at various points. (Geol. Mag., Oct., 1893.)

From the evidence of marine fossil shells in the Bowlder Clay on the Bay of Fundy just west of Saint John harbor, Dr. Robert Chalmers concludes that the height of the land on this part of the Bay during the Glacial period must have been 100 to 200 feet lower than at the present day, relatively to the sea. Also since the striæ on the rocks underneath the bowlder-clay indicate several ice movements varying in direction from S. 2° W. to S. 65° E. the formation of the lower bowlder-clay cannot all be due to one body of ice. (Bull. Geol. Soc. Am., 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Schists of Southern Berkshire, Massachusetts.—The sericite schists of southern Berkshire Co., Massachusetts, and northern Litchfield Co., Conn., contain phenocrysts of feldspar, garnet, staurolite, tourmaline, biotite, and ottrelite, imbedded in an aggregate of feldspar, quartz and sericite, which contains, besides the phenocrysts, a large number of metamorphic minerals. The large feldspars are often filled with secondary granophyre, and this mineral, the garnet and the tourmaline, are frequently built out by secondary enlargements. The core of the feldspar is so often bounded by crystal outlines that Hobbs[2] regards the mineral as having resulted from the recrystallization of the clastic grains of the original rock. The garnets, in addition to their peripheral enlargements, are often possessed of a rim of staurolite and magnetite crystals, supposed to be the product of reactionary action between the garnet and the surrounding minerals. The author believes the phenocrysts to have been developed by static metamorphism (simple pressing) from the constituents of a fragmental rock.

The Phonolytes of the Hegau.—The phonolytic rocks of the Hegau, Eifel, Germany, so well-known because of the beauty of their hauyne constituents, have been subjected to a comparative study by Cushing and Weinschenk,[3] who find them not all phonolites, as they have heretofore been regarded. The essential characteristic constituents of the group are sanidine, nosean, hauyne, nepheline, leucite, augite and aegerine, and the accessories, biotite, apatite and zircon. All the rocks are more or less porphyritic, with sanidine and the members of the hauyne group in two generations. Of the latter the larger crystals and those of the first generation are hauyne; the smaller, those of the second generation, nosean. The former are always more or less altered into zeolites, while the latter are usually fresh. Contrary to the general statement made with regard to these two minerals, the hauyne is not always blue nor the nosean colorless, but rather is the opposite the case. An important discovery made during the investigation is to the effect that nepheline is by no means common in the Hegau rocks. In a few of them the mineral is abundant in the usual form. In others it is only sparingly present, while in still others it is absent so far as could be learned. Consequently, the rocks fall into several classes. The Hohentwiel occurrences are of nosean-phonolites, in which nosean is abundant in the groundmass and nepheline absent. The specimens from Mägdeberg and Schwindel are nosean-ophyres (corresponding to the leucitophyres), in which nosean and nepheline are both present. At Staufen, two types were found, one a leucite-phonolite, and the other a true phonolite (nepheline-phonolite). The rock of Gonnersbohl is a hauyne-bearing trachyte or a trachytic phonolite. Each of these types is briefly described, and at the conclusion of the paper a few pages are devoted to an account of the tufa associated with them.

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. Geol. Soc. Amer., Vol. IV, p. 167.

[3] Minn. u. Petrog. Mitth., XIII, p. 18.

The Rock of a New Island, off Pantelleria.—An island, measuring one kilo. in length, and two hundred metres in width, was projected above the water off Pantelleria during the earthquake week beginning Oct. 14, 1891. The new island is an aggregate of loose blocks and solid lava, whose characteristics have been described by Foerstner.[4] The material in his possession was mainly a black pumiceous basalt of the composition:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total
44.64	5.86	12.74	4.21	11.17	.20	10.12	5.82	1.41	4.31	.51=	100.99

Attention is called to the large quantity of TiO_2 revealed by the analysis. Under the microscope the groundmass of the rock is seen to be a dark glass filled with highly colored microlites, and enclosing phenocysts of anorthite, olive-green augite, olivine and magnetite. The glass is sometimes in large quantity and at other times is present only in traces. The rock is a tachylitic basalt like that of Pantelleria and the other neighboring islands.

Petrographical News.—The pyroxenite of Duerne, Dept. of the Rhone, France, is an aggregate of orthoclase, pyroxene, oligoclase, garnet, and quartz. The structure of the rock varies from pegmatitic to granular. Its pyroxenic component is described by Gonnard[5] as light green in color, and as often possessing crystal outlines. It includes within its mass many crystals of sphene. Druses of vesuvianite line the walls of crevices in the rock, and galena is not an uncommon constituent of tiny veins traversing it.

---

[4] Minn. u. Petrog. Mitth., XII, 1892, p. 510.

[5] Bull. Soc. Franc d. Min., XV, p. 232.

In the northern Hardt Mountains, near Obbersweiler, Waldhambach and the neighboring regions, are biotite and hornblende gneisses that are probably squeezed granites, schists and graywackes, altered by an intrusive biotite granite and cut by other granites, a kersantite dyke cutting the intruded granite, and a sheet of quartz melaphyre overlyng all these as a lava flow, the whole comprising the mass of the mountains. All these rocks Leppla[6] discusses in a recent article, describing the melaphyre as consisting of a groundmass of plagioclase and quartz enclosing phenocrysts of feldspar, red olivine pseudomorphs, quartz and bastite. The quartzes are all surrounded by aureoles of augite, just as are the quartz inclusions in many basic rocks.

In a monograph in the Kaiserstuhl in Baden, Knop[7] gives a general view of the geology, mineralogy and chemistry of this interesting volcanic region, in addition to statements concerning its hydrography, botany, history, etc. All the minerals known to the region are described at considerable length, and over a hundred and fifty pages of the book are devoted to descriptions of its interesting rocks, phonolites, andesites, tephrites, basanites, basalts, limburgites among the volcanics, and several others of sedimentary origin. The author treats the hill as an old volcano, and attempts to explain the variety in its products upon the Bunsen theory of mixed magmas.

A two-mica gneiss[8] constitutes the principal rock of the Valley of Miñor, Provice Pontevedra, Spain. On the peninsula of Santa Marta it is cut by a diabase with faintly pleochroic augite. At Monte Galeñeiro the micaceous gneiss is replaced by a hornblendic variety in which the prominent amphiboles are glaucophane and a green variety opaque to light vibrating parallel to *c*.

Chelius[9] describes very briefly several occurrences of nepheline basalt from the Odenwald, Germany, and records the analyses of the red gneiss of Steinkopf, of the dark biotite gneiss of Bockenrod, of basalt from the Häsengebirg near Urberach, of granite from the Melibocus massiv, and the results of silica and specific gravity determinations of many other rocks from the same region, among which may be mentioned malchite and alsbachite.

---

[6] Zeits. d. deutsch. geol. Ges., XLIV, p. 400.

[7] Der Kaiserstuhl in Breisgau. Ein naturwissenschaftliche Studie von Dr. A. Knop. Leipzig. W. Engelmann, 1892, p. 538 and fig. 89.

[8] Quiroga: Actas d. l. Soc. Esp. d. Hist. Nat., XXI, 1892, pp. 4 and 8.

[9] Notizbl. d. Ver. f. Erdk. Darmstadt., IV, 1891, H. 12.

Though the parallel growths of augite and hornblende, with the latter mineral surrounding the former, are common, the reversed phenomenon is rare. Hobbs,[10] however, has recently pictured an example of light green amphibole completely encircled by colorless augite from an augite-hornblende rock occurring at New Marlboro, Mass.

Analyses of American Minerals.—Several analyses of dodecahedral crystals of *aguilarite* from Guanajuato, Mexico, have been made by Genth and Penfield.[11] That from the purest material gave: Ag = 84.40 % ; Cu = .49 % ; S = 11.36 % ; Se (diff) = 3.75 %. The mineral is thus an argentite with an eighth of its S replaced by Se. *Metacinnabarite* particles disseminated through barite from San Joaquin, Orange Co., Cal., gave the same authors: Hg = 85.89 % ; S = 13.69 % ; Cl = .32 %. The mineral supposed to be *leucopyrite*,[12] from Alexander Co., N. C., is *lollingite*, whose composition is Fe = 70.83; Cu = tr; As = 27.93 % ; S = 77 %. *Rutile* crystals with the habit of cassiterite are found in the quartz decomposition products of the orthoclase from West Cheyenne Cañon, El Paso Co., Col. They are iron black with a density of 4.249, and the composition: $SnO_2 = 1.40$; $TiO_2 = 91.96$; $Fe_2O_3 = 6.68$. The *quartz* decomposition products referred to yield, upon analysis:

SiO_2	Al_2O_3	Fe_2O_3	Na_2O	K_2O	Loss		Total
96.63	.93	.85	tr.	.46	.95	=	99.82

Pieces of a large *danalite* crystal from the same locality, give:

SiO_2	BeO	CuO	ZnO	FeO	MnO	S.	Loss	Total—O
30.26	12.70	.30	46.20	6.81	1.22	5.49	.21	100.41

The danalite is associated with quartz, astrophyllite and a new yttrium calcium fluoride with a hardness of 4 and a density of 4.316. Its composition is: CaO = 19.41; $(Yt\ Er)_2O_3 = 47.58$, etc. The other minerals whose analyses are recorded by the authors, are: altered zircon (*cyrtolite*) from Mt. Antero, Col.; *lepidolite*, from Tanagama Yama, Japan, and *fuchsite*, from Habershaw Co., Ga. The analyses of the lepidolite and fuchsite follow:

---

[10] Sci., Dec. 23, 1892, p. 354.

[11] Amer. Jour. Sci., Nov., 1892, p. 381.

[12] Bull. U. S. Geol. Survey, No. 74, p. 26.

	SiO_2	Al_2O_3	F_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O	H_2O	Fl	Cr_2O_3	CuO
L.	53.34	17.76	3.25	2.77	.05	.37	4.60	1.55	10.90	.65	7.78		
F.	46.73	29.00	2.59		3.03			.26	9.25	6.04		2.73	.14

Among some analyses[13] made in the laboratory of the University of Virginia are the following, which are of interest to mineralogists: *Cuproplumbite* from Butte City, Montana, analysed by De Bell, gave: $Cu = 61.32$; $Pb = 18.97$; $S = 17.77$; quartz $= 1.58$; corresponding to $5\ Cu_2S.PbS$. *Calamine,* from New River, Wythe Co., Va., yielded Jones: $SiO_2 = 25.33$; $ZnO = 67.15$; $H_2O = 7.47$; Total $= 99.95$. *Parantite,* from a pocket in a corundum vein of the Hiawassee Corundum mine, Hayesville, Clay Co., N. C., is associated with decomposed albite and various chlorites. It is in rounded blue-gray lumps, having a density of 2.75. Analysed by Berkeley, it gave:

SiO_2	Al_2O_3	CaO	Na_2O	H_2O		Total
47.54	34.03	17.23	1.82	1.02	=	101.64

North American Minerals.—Remarkably large crystals of *seleeuite* have been found by Talmage[14] in the drainage area of one of the side cañons of the Tremont River, Wayne Co., Utah. Gypsum in seams cuts through the sandstone and argillite of the region in great profusion. The largest crystals of the minerals were in a geode-like cave, left exposed as a hollow mound in the slope of a hill. The interior of the cave was studded with great columns and slabs, extending from its sides sometimes to a distance of 51 inches. Many of the crystals are transparent throughout their entire length.

Fairbanks[15] describes the *rubellite* and *lepidolite* of southern California as occurring in a pegmatite vein cutting norite near Pala, west of Smith's Mt, San Diego Co. Besides the feldspar and the quartz there are associated with the two minerals above mentioned: muscovite, hematite, and green and black tourmalines.

A few very fine *datholite* crytals from the Lacy Mine, Loughboro, Ontario, have been measured by Pirsson.[16] The manner of their occurrence is not certainly known, but they appear to be in a vein penetrating an eruptive rock. The crystals are described as the finest yet

[13] Amer. Chem. Jour., Vol. XIV, 1892, p. 620.

[14] Science, XXI, 1893, p. 85.

[15] Ib. XXI, p. 35.

[16] Amer. Jour. Sci., Feb., 1893, p. 100.

found in America. They are transparent, yellowish, and in size the largest measure 3 x 2.5 x 2 cm. Their habit is prismatic parallel to *a*, and each individual is bounded by many faces.

In and upon calcite crystals lining some of the geodes of Keokuk, Iowa, Keyes[17] announces the discovery of very handsome tufts and radiating masses of *millerite*.

Beds of specular *hematite*, intermixed with *martite*, are reported by Hill[18] as abundant at the junction of diorite and limestone in many localities within the State of Coahuila, Mexico.

Physical Properties of Minerals.—A series of new determinations of the specific heat of *boracite* at different temperatures is reported by Kroeker.[19] The materials experimented upon were four transparent crystals from Linneberg, one piece being from a large crystal with a cubical habit, and the others fragments of dodecahedral crystals. In all cases it was found that the specific heat of the mineral varies with the temperature, and that the increment of variation increases rapidly between 250°–270°. Below 270° the cubic and the dodecahedral crystal gave similar results, above this temperature the results are different. For details of the experiments the reader must be referred to the author's paper.

Two articles of interest to mathematically inclined physical mineralogists are the one by Pockels[20] on the changes effected in the optical characterists of *alum* and *beryl* by pressure acting in a single direction, and the other, by the same author,[21] on the elastic deformation of piezo-electrical crystals in the electrical field.

Traube[22] finds that the following compounds, all of which form dextro-rotatory solutions, are hemi-morphic, viz.: $Sr(SbO)_2(C_4H_4O_6)_2$, $Pb(SbO)_2(C_4H_4O_6)_2$, and $Ba(SbO)_2(C_4H_4O_6)_2+H_2O$. All are also tetartohedral—the strontium and lead compounds being the first examples of hemimorphic tetartohedral substances crystallizing in the hexagonal system, and the barium salt the first instance among tetragonal bodies.

---

[17] Amer. Geologist, XI, p. 126.

[18] Amer. Jour. Sci. XLV, p. 111.

[19] Neues Jahrb. f. Min., etc., 1892, p. 125.

[20] Neues Jahrb. f. Min., etc., B. B. VIII, p. 217.

[21] Ib. B. B., VIII, p. 407.

[22] Ib. B. B., VIII, p. 269.

One of the micas[23] in the Mte. Dorè trachyte is an *anomite* with an optical angle of 41°. When treated with boiling hydrochloric acid it loses its greenish color, with the extraction of its iron and magnesium, and becomes less strongly doubly refracting. After an hour's treatment it becomes colorless and uniaxial, when its optical sign is negative.

Having examined seventy-one uniaxial minerals with respect to their heat conductivity, Jannetaz[24] finds that only five contradict his law that the major axis of the isothermal ellipsoid is parallel to the direction of the principal cleavage, and the minor axis normal thereto.

Instruments.—Laspeyres[25] describes a modification of the setting of the condenser above the polarizer of the microscope, that enables the observer to change rapidly from converged to parallel light, even when an object is being examined. The lower nicol is in its usual position. The condenser is imbedded in a metal strip set into the stage, and sliding easily in a groove prepared for it.

A goniometer with two circles, enabling the operator to measure nearly all the planes on a crystal with one adjustment of the latter, is explained in detail by Goldschmidt,[26] who also illustrates its use by several examples.

[23] Bull. Soc. Franc d. Min., XV, 1892, p. 97.
[24] Ib. XV, p. 183.
[25] Zeits. J. Kryst., XXI, p. 256.
[26] Ib., p. 210.

ZOOLOGY.

The Molluscs of the Water Mains of Paris.—M. Locard has made a study of the malacological fauna of the water mains of Paris as represented in the material now in the possession of the Geneva Museum. The author finds that the collection embraces 44 species referable to 13 genera. Among them are four new species, *Dreissensia paradoxa*, *D. curta*, *D. tumida* and *Amnicola lutetiana*. Neither Unios or Anodontas are found. The author attributes their absence to the absence of fish to which the larvæ of these species are in the habit of attaching themselves.

M. Locard notices four modifications of the molluscs in the water mains of Paris from the original types whose habitat is in the waters supplying these mains. (1) Diminution of size, due to absence of light. (2) Decrease of coloration owing to the same cause. (3) Modifications of form, generally a lengthening of the shell, due to the mechanical action of a steady, rapid current. (4) Appearance of the shells. They are polished, brilliant, uniform, developing with regularity in a constant medium. (Revue Scientifique, Oct., 1893).

The Orthopterous Insects of the Galapagos Islands.—The various collections of orthopterous insects, the result of nine different explorations of the Galapagos Islands, have been examined by Mr. Samuel Scudder, and form the subject of a paper published in the Bull. Harv. Mus. Comp. Zool., Vol. XXV. The author notes the poverty of this Orthopteran fauna. In all there are but 25 species, of which 5 are cock-roaches, which can in no sense be considered endemic. The remaining 15 include 7 new species, and are all South and Central American in their affinities. A large proportion of the forms are incapable of flight, which can be accounted for only on the supposition that the Galapagos are of recent origin, and that the present Orthopteran fauna is derived from the chance advent of pregnant females from the nearest shore, or the shores which currents of the ocean practically make the nearest. The insect incapable of flight would stand the best chance of reaching the island, since it would have less inclination to leave its floating refuge, and thus the exceptional proportion of subapterous forms is explained.

An Axillary Pocket in Certain Chameleons.—In examining a collection of Reptiles sent from Madagascar to the Natural History

Museum of Paris, M. Mocquard discovered a pocket in the armpit of certain species of Chameleons, a character hitherto unnoticed. This pocket is formed by the invagination of the skin, and is about 4 mm. in depth, with an orifice of 2 mm. in diameter, varying slightly in size in different species.

This character appears to be constant in certain species only of Chameleons peculiar to Madagascar and the neighboring islands of Mauritius and Bourbon, for it does not appear in all of them, nor is it found in the Chameleons of the Continent, except in *C. vulgaris* in which a rudimentary pocket can be discerned. It is found also in *Rampheoleon spectrum*, a west African species, while not a trace of the character can be seen in *R. kerstenii*, which belongs on the eastern coast.

M. Mocquard considers this character of specific importance, and recommends its use in determining different species of Chameleons. (Compte-rendu Soc. Philom., Paris, July, 1893.)

The Origin of the Human Face.—In two short essays entitled The Origin and Evolution of the Human Face and Descent of Facial Expression, Dr. Alton H. Thompson gives a compilation of the literature of the subject with some original notes. His comments are intelligent and show a just appreciation of the idea of evolution. In the first essay the author keeps in view the point that the face and the brain were developed collaterally, and the high perfection of the face in man is due to his high brain development. The second essay is a contribution toward finding a scientific basis for the study of physiognomy and expression. Some of the varieties of feature of the human face are traced back to their animal origin, and the inheritance of emotional expression from the lower animals is touched upon. The essay is based on the facts of both phylogeny and ontogeny, and is an excellent synopsis of what has been written on the subject, to which several important original thoughts are added.

The Ground Squirrels of the Mississippi Valley.—In a paper recently published by the United States Department of Agriculture, Mr. Vernon Bailey describes the food habits and distribution of the five species of Spermophilus found in the Mississippi Valley. In addition, he summarizes the best methods of holding them in check, the preference being given to the use of bisulphide of carbon. The essay is handsomely illustrated. (Bull. No. 4, Div. Ornith. Mam. U. S. Dept. Agri., 1893.)

Zoological News.—Three new species of Annelids from the New Jersey coast are described and figured by Mr. J. P. Moore. *Clymnella elongata*, a tube dweller; *Eulalia lobulata*, so-called from the lobulated appearance of the peculiar tentacular appendages; and *Eracia brevicornis*. (Contributions Zool. Lab. Univ. Penna., Vol. I, 1893.

In a report on the Aquatic Invertebrate Fauna of Wyoming and Montana, Mr. S. A. Forbes describes and figures several new species and varieties. The list comprises 5 Cladocera, 1 Ostracoda, 8 Copepoda, 2 Rotifera and 1 Protozoa. The investigation of this fauna was made with a view to stocking the lakes of Yellowstone Park with game-fishes. During the years 1890 and '91, 66 localities were visited, and the material gathered amounted to 460 collection numbers. (Bull. U. S. Fish Commissioners for 1891).

VERTEBRATA.—The Zool. Dept. of the Michigan Agri. Exp. Station has issued an illustrated list of the Birds of that State prepared by Mr. A. J. Cook. The author has adopted the arrangement of the Am. Ornith. Union, and has appended, in parenthesis, the number of the species as given in Coues' Key and Check-List. A résumé of the species show that the bird fauna of Michigan includes the Boreal, the Transition and the Sonoran. The large lakes attract many birds that are usually maritime, while the prairies and woodlands in the southern part of the State afford a habitat for the prairie birds and a long list of woodland warblers. All species of doubtful occurrence have been excluded from the list. So far as observation permits, the author has given the food habits of the species described. An extensive bibliography appended to the introduction adds to its value to the Ornithologist.

Mr. Gerrit S. Miller calls attention to the rediscovery of the gopher—*Thomomys bulbivorus*—at Beaverton, Oregon. This animal, described sixty years ago by Richardson under the name *Diplostoma bulbivorum*, has been entirely unknown to naturalists until the present day. (Proceeds. Biol. Soc. Wash., Aug., 1893).

EMBRYOLOGY.[1]

Frog Eggs under Pressure.—Professor G. Born[2] describes some interesting experiments made upon cleaving eggs of the frog. The eggs were subjected to pressure by confinement between glass plates that pressed upon the jelly about the egg and flattened out the egg itself so that its diameters were as 2 to 3 or even, in extreme cases, as 1 to 2.

The eggs were put between the plates before fertilization and could thus be arranged carefully with reference to the relative position of the main axis of the egg and the surface of pressure. Glass strips between the glass plates kept these apart a certain distance, say 1·4 mm.

Under these conditions cleavage takes place and the medullary folds may arise and even close over.

If the eggs stand in their normal vertical position—i. e., with the dark side uppermost and the horizontal plates press then thus in a direction parallel to the chief or vertical axis of the egg, the following departures from the normal cleavage take place.

The third cleavage is not, as normally would occur, by a horizontal furrow at right angles to the first and second furrows, but by two vertical furrows on either side of and parallel with the first furrow. The planes of the 1st, 2d and 3d cleavages are thus all at right angles to the pressing plates. This is true also of the 4th cleavage which is accomplished by two planes parallel to the 2d cleavage plane and at right angles to the first.

In such eggs, kept under pressure, the blastopore and subsequently the medullary folds appear upon the under side of the egg; the ventral part of the embryo is upward in these compressed, fixed eggs.

If the eggs are arranged so as to be squeezed from the sides, are compressed between plates parallel to the main axis of the egg, which stands vertically, then the following unusual cleavage phenomena are seen.

The first plane being as usual vertical, is also at right angles to the pressing plates; the second is not vertical as normally would be the case, but horizontal. The third cleavage is often expressed by two planes parallel to the first, while the fourth may be parallel to the second.

---

[1] Edited by Dr. E. A. Andrews, Baltimore, Md.

[2] Anatomischer Anzeiger, VIII, Aug. 5, '93, pps. 609–627.

These departures from the normal might be due to the direct effect of the pressure acting upon the dividing nuclei or else to the secondary effects brought about through the change of form the egg suffers under the pressure.

While Pflüger was inclined to regard the pressure as acting directly, as determining the direction in which the nucleus could most easily elongate, the author thinks that the change of form of the protoplasm is the determining cause of the new arrangement of the cleavage planes. He thinks that these phenomena may be brought under the rule formulated by O. Hertwig, that in dividing the nucleus tends to get into the center of its field of action, the surrounding protoplasmic mass, and places itself so that its poles are toward the largest masses of protoplasm.

It is thus not the pressure which directly alters the position of the nuclear spindle but the forced change of form of the protoplasm of the cell which necessitates an adjusted position of nucleus and hence a subsequent change in the direction of the cleavage.

If the author succeeds in making out in detail this mass effect of these distorted cells we would seem to have additional reason for regarding the nucleus as of less value than the protoplasm in the determination of form.

Embryology of Chiton.—Dr. M. M. Metcalf studied the embryology of *Chiton marmoratus* and *C. squamosus* at Jamaica, where the Marine Laboratory of the Johns Hopkins University was located in 1891. An account of the breeding habits, methods of studying the small opaque eggs (use of hardening liquids, hypochlorite of soda to remove the chorion and yolk, etc.) and a detailed, illustrated description of the cleavage and gastrulation is given in the last number of the Studies of the Biological Laboratory, Baltimore, October, 1893.

The eggs were obtained from specimens kept in aquaria; both eggs and sperm are discharged for a period of two hours or more after a time of active, sexual excitement. The males and females, however, do not approach one another but seem to give off the sexual cells under the stimulus of some unknown influence.

The cleavage is described and figured in great detail chiefly from surface views of living eggs, and from reconstruction of sections up to the forty cell stage. The gastrulation also is given in detail and presents interesting features with reference to the slit like form of the blastopore in Peripatus. Later stages are reserved for subsequent work. In general the results here given confirm the work of Kowalevsky.

Lithium Monsters.—Curt Herbst[3] has continued his work[4] upon the action of salts upon echinoderm larvæ and publishes a full account, with careful figures, of the various abnormal or monstrous larval forms produced by the action of very dilute solutions of lithium chlorid.

Both Sphærechinus and Echinus give results though Asterius, and presumably other animals, act differently or not at all under the influence of this salt.

The eggs are fertilized and then put into sea water containing 2½% of the lithium solution. This solution itself is, however, very weak, only 3·8 g Li Cl to 100 cm hydrant water.

The blastulas that arise from these eggs have thick walls with the inner end of their cells much vacuolated at first, but as they enlarge become elongated vesicles with thin walls. This vesicle becomes constricted into two, more or less separate; one has a thicker wall and long cilia, the other a thinner wall and short cilia. Between the two an intermediate, connecting vesicle may subsequently be interpolated.

Now it is evident that one of the vesicles, the one with thin cells of long cilia represents the ectodermal part and the other vesicle, the thick walled one, the entodermal part of a gastrula turned inside out; for there are all transition stages between these double vesicles and what the author calls exogastrulæ. These are evidently gastrulas in which the entodermal tube protrudes as a closed, thick walled process just as would be formed if the entoderm grew outward instead of inward as normally happens.

Invagination being due to a rapid growth of a zone of cells on the vegetative side of the blastula we need but have the direction of growth changed, by the lithium salt, to produce such an exogastrula. If this zone of growth extend, under the influence of the salt, more and more over the vegetative side of the blastula there will result a more typical lithium larvæ, or stages between it and the exogastrula. Finally some cases arise in which it seems that this zone extends all over the blastula; such larvæ are mere single vesicles of entoderm! There is thus a conversion of what would normally form outside and inside, ectoderm and entoderm, of the gastrula, into what may be styled entoderm only.

The author thus agrees with Driesch in regarding the cells of the early larvæ as omnipotent in their capabilities; they may become ectoderm or entoderm; the idioplasm is not early divided qualitatively amongst the cells as Raux and as Weismann maintain. This same lack of differentiation is shown, the author holds, by certain other abnormalities sometimes produced when the embryos are subject to the action of lithium. Thus larvæ may be reared in which the arms and ciliated band are formed in abnormal places, from cells, apparently, which would not normally form such structures at all, i. e., cells have been induced to form what they would not be able to form were they really specialized.

---

[3] Mitth. Zool. Sta. Neapel. II.

[4] See AMERICAN NATURALIST, March, 1893.

From the wealth of observation upon the action of lithium at different stages of larval life exposed for different periods to this action we can select only one of the interesting facts that result, namely, that the action of this salt does not cease when the egg is removed from the salt into pure sea water. Under some conditions such eggs may continue to develop along the abnormal direction or may begin to form lithium larvæ, though as far as can be seen they are perfectly normal when removed from the salt into the sea water. Such facts militate against the author's former assumption of the direct action of these salts in modifying the osmotic penetrability of the egg protoplasm and show that the action is a more subtle, unknown one.

The author argues that the entoderm cells of the blastula have the property of taking up and holding the lithium salt to a greater extent than do the ectoderm cells. In some unknown way this is connected with their unusual mode of growth.

It is important to note that the eggs of different individuals react to quite different extents, different degrees, to the stimulus produced by the same amount of the lithium salt.

Mechanics of Embryology.—Hans Driesch[5] adds four more chapters to his six previous contributions to this subject.

The first treats of the results obtained when the eggs of Sphærechinus are put, about twenty-six hours after fertilization, into water that is kept for eighteen hours in a warm chamber heated at 30° C.

The larvæ that result are blastulas with a protruding tube on one side; in fact the increased temperature has brought about the same result as Herbst obtained by the use of lithium salt, the gastrulations begin in an inverted sense, the entoderm grows outward instead of inward. Such *exogastrulæ* when removed to cooler water continue to live and may form plutei with long entodermal tubes attached; in each case the entodermal tube, or more properly closed pouch, is divided

[5] Mitth. Zool. Station Neapel II. 1893.

into three regions as it would be if it grew inside the ectodermal vesicle or body wall.

The entodermal tract remains small—does not swell out as in the lithium larvæ—and ultimately shrinks and falls off.

In this way *anenteria* are formed, or plutei having no entoderm. Yet in these there is formed a small oral invagination without the presence of the entoderm. Such *anenteria* lived a week, but did not regenerate the digestive tract.

The second chapter deals with the effects produced by water containing less than the normal percentage of salts. Eggs of Echinus as soon as fertilized, are put into sea water to which fresh water has been added in the proportion of 45·5; after five minutes they are transferred to 40·10 and then 35·15 and so on to 25·25.

The eggs swell, cleave normally in 45·5 but abnormally in 40·10 and 35·15; while in 30·20 only the nuclei divide; in weaker solutions the eggs die. The abnormal cleavage above mentioned consists in the unequal size of the cells formed in the eight cell stage. Here there are 2 to 4 cells so small that they may be called micromeres. In the weaker solution, 35·15, there is added tbe shifting of the cells into a tetrahedral arrangement not otherwise present.

Having thus produced apparent micromeres by varying the percentage of salts in the sea water, the author regards the normal micromeres as not essentially different from the macromeres in their nuclei or idioplastic parts, but as merely a result of the activity of the protoplasm; protoplasm may be effected by external agencies so as to make micromeres when they are not predetermined by any character of the nuclei.

The third section takes up his previous conclusions as to the interchangeableness of the ectoderm and entoderm in their beginning. Not satisfied with the facts formerly relied upon to show that what would be ectoderm cells could form entoderm and vice versa, attempts were made to determine the relation between the position of the micromeres and the place of origin of the entodermal invagination. But the experiment failed, since the eggs revolved in the capillary tubes in which they were reared and so made conclusions invalid. A second series of experiments was successful in showing the independence of micromeres and entoderm and also in demonstrating that cells normally destined to form the vegetative side of a blastula could form a complete larvæ, while cells that should have formed the other half of the blastula could also form a complete larvæ.

These experiments consisted in shaking off one or the other sets of cells in the sixteen cell stage, after the egg membrane had been removed. At this stage there are eight equal cells, of the vegetative region, four large cells and four micromeres of the animal region. Complete pleuti arise when the micromeres are absent; when only some of the above 8 negative cells are present.

The facts in connection with the author's previous experiments upon compressed eggs show, he thinks, that the nuclei of a cleaving egg are equivalent and that the germ layers are not separated during cleavage by any qualitative nuclear divisions.

The presence of micromeres is shown to be unnecessary for the formation of an echinus gastrula.

(Some attempts to form fusions of cleaving eggs are mentioned here, though they were not successful; the eggs adhered (after treatment with chloroform) but eventually separated again).

The last chapter deals with some fundamental questions and results reached by this mode of investigation.

The outcome of all the author's work is in opposition to the views held by Roux and Weismann, for it is shown that the cleaving egg, at least in these echinoderms, is not differentiated as regards its nuclei which are all alike in quality. Not so the protoplasm of the eggs which the author maintains must be anisotropic from the first, must possess a differentiation in direction so that all of it, or a part of it when removed, acts like a stimulus in producing the first differentiation of form, which is the first difference between the ends of the main axis of the larvæ. When the larva becomes bilateral this is due to a like direct specialization in the protoplasm, finding its expression in the difference seen between the dorsal and ventral sides of the larvæ.

Some organs may owe their position directly to this determined axial condition, others may arise from more indirect causes, from stimul· that come either from other separate organs or from without the organi ism.

Cells become this or that according to their position; the organs arise as functions of the positions of the cells forming these organs. Thus is the peculiar half-dead embryo Roux obtained in the case of the frog; the cells are forced to remain in their original or normal positions by the presence of the dead half-embryo; if this were away the cells could rearrange themselves and so coming into new positions would form one complete embryo, not a half embryo.

The evolution of form in an individual is the result of stimuli and reactions of a complex interacting nature. These only are investigated in "entwicklungsmechanische studien." The primal origin of form lies in the ovum; the ontogeny is not true epigenesis but rather an evolution, since the protoplasm at the first has a tendency toward direction, is an-isotropic; this initiates the subsequent actions and interactions of parts.

This branch of biological study thus leads back only to something having determined form, not to a physicochemical starting point; the problems of morphology are not physicochemical problems.

ENTOMOLOGY.[1]

Lycænid larva on Atriplex.—On July 6, 1892, I beat several small lycænid larvæ from *Atriplex canescens*, 12 miles north of Cedar Ranch, Arizona, on the stage road from Flagstaff to the Grand Cañon. The larvæ were of almost the same shade of color as the bush and leaves, of a very light whitish-green, thus easily escaping detection. If I am not mistaken they fed on the underside of the leaves.

Description of larva.—Length (in strongly curved position), 5 mm.; width, 2½ mm. Thirteen jointed, strongly curved (after immersion in alcohol), arched, broad, somewhat flattened, tapering to head, more rounded posteriorly. In color pale whitish-green, head shining jet black; a median dorsal, and two lateral rows (one on each side) of reddish spots, one spot to each segment, on segments 3 to 10; those on anterior segments much fainter usually, especially the lateral ones. Often a faint row of smaller spots ventrad of the lateral row. Head very small compared with other segments, hardly more than one-third the width of the prothoracic segment, within which it is usually retracted; subhemispherical in shape, convex dorsally, glabrous, well polished and shining. All the other segments thickly covered with minute short white spine-like tubercles, with a less number of similar black ones interspersed. These extend on the ventral portion, which is besides clothed with some short whitish hairs along sides and on prolegs. The anterior portion of dorsum of prothoracic segment is furnished with more numerous and larger short and stout black spines. Prothoracic segment subtriangular in outline from above, a little rounded in front, widening behind; segments 3 to 6 widening posteriorly, each wider than its predecessor; segments 7 to 10 about equal in width, a little wider than 6; 11 and 12 gradually narrowing from 10; 13 considerably narrower than 12 (in some specimens regularly narrowing from 12), rounded posteriorly, with a terminal somewhat narrower and partially free joint which bears the terminal or anal pair of prolegs. Segments 3 to 8 each gathered into a transverse, slightly curved, more or less hump-like ridge on dorsum, the prothoracic segment with a strongly anteriorly bent one, segments 9 to 11 hardly humped, segments 5 to 8 usually most strongly so. Eyes represented by five small glassy simple eyes, four of them arranged in a semicircle with the outside anterodorsad, the fifth postero-ventrad of the four. Mandibles minute,

---

[1] Edited by Prof. Clarence M. Weed, New Hampshire College, Durham, N. H.

7-toothed (6-notched) on the very broadened and circular apical margin, brownish. Other trophi light colored. Spiracles somewhat raised, situated on side posteriorly of prothoracic segment, and on sides of segments 5 to 12, those on 11 and 12 situated higher up on dorsum and more removed from the lateral margin. Three pairs of short hook-like true or thoracic legs; and five pairs of fleshy prolegs, on segments 7 to 10 and terminal joint of 13.

Note.—The segment which is called a terminal joint of segment 13 may perhaps be regarded as the thirteenth segment. In this case the slightly hood-like or flap-like portion which projects over it from the twelfth segment would necessarily be regarded as a posterior development of that segment.

Described from 3 specimens. Color noted in life. Arizona. The special organs described by Mr. W. H. Edwards, in his second volume of the Butterflies of North America, as found on segments 11 and 12 of the larva of *Lycœna pseudargiolus*, are also present in the above larvæ on *Atriplex.* The median transverse opening on 11 is very plain, but the two retracted tubes on 12 do not show as plainly as figured by Mr. Edwards. These latter show very much more plainly in lycænid larvæ which I have taken in southern New Mexico on mesquite in May. —C. H. TYLER TOWNSEND.

Honey Adulterations.—There has been in the past much difference of opinion among chemists and beekeepers concerning the detecttion of honey adulterations by chemical methods. To obtain more definite information on the subject Professor A. J. Cook recently had samples of a large number of kinds of honey analyzed by Professor H. W. Wiley of the U. S. Department of Agriculture, Professor R. C. Kedzie of the Michigan Agricultural College, and Professor M. A. Scovell of the Kentucky Agricultural Experiment Station. The results of these analyses are published in Bulletin 96 of the Michigan Station, and from them Professor Cook draws these conclusions:

1. That chemists can easily detect adulteration of honey by use of glucose, in all cases where it is likely to be practiced. The same would be true if cane sugar syrup were mixed with the honey.

2. That a probable method to distinguish honey dew honey from honey adulterated with glucose has been determined by these analyses. The right-handed or slight left-handed rotation together with the large amount of ash, and small amount of invert sugar indicate honey dew honey. As honey dew honey will never be put onto the market, this question is of scientific rather than practical importance.

3. As yet the chemist is unable to distinguish between cane suga syrup honey—by which we mean cane sugar syrup fed to the bees and transformed by them into honey, and not cane syrup mixed with honey, which is adulteration pure and simple, though a kind not likely to be practiced—and honey from flowers. As the best cultivated taste cannot thus distinguish, this seems of slight importance. If it should prove to be important to be able to distinguish them it is probable that the chemist will discover the means, as chemistry has very delicate eyes, and can usually search out very slight differences.

North American Noctuidæ.—Professor Smith has furnished a striking example of his industry as a student of the Noctuidæ in his recent catalogue[1] covering 424 pages, which are nearly all devoted to the catalogue proper. The preface consists of a statement of the collections in America and Europe examined by the author, with explanations of the methods adopted in preparing the catalogue. This is followed by an index of authors and works cited, and the bulletin closes with a very complete index in which every name used in the body of the bulletin is included. This index covers 25 double-column pages in small type which will give some idea of the extent of the family and the completeness of the catalogue.

Recent Bulletins.—The entomologists of the experiment stations continue active in issuing publications concerning injurious insects. The subjects chosen cover a wide range, and while much of the matter consists of a republication of existing information—a legitimate function of the stations—a good deal of original knowledge is being brought out. In Bulletin, 32 of the West Virginia Station, Mr. A. D. Hopkins presents a catalogue of the Forest and Shade tree insects of that State. The list includes 494 species, only a part of them, however, being injurious, the others being parasitic or predaceous, or living under the bark of fallen logs. Mr. Hopkins has paid special attention to the Scalytidæ and is accomplishing valuable results in their study.

In Bulletin No. 24 of the Colorado Station Professor C. P. Gillette treats of "A few Common Insect Pests." The species discussed are enemies of cabbages, onions and other garden-crops. A Thrips, doubtfully identified as *T. striatus* Osborn is reported to do serious injury to onions.

---

[1] A catalogue, bibliographical and synonymical, of the species of moths of the Lepidopterous superfamily Noctuidæ found in Boreal America. With critical notes, by John B. Smith, Sc. D., Bull. U. S. Nat. Museum, No. 44.

In Bulletin 98 of the Michigan Station Mr. G. C. Davis briefly discusses locusts (*Acrididæ*) and the Horn Fly (*Hæmatobia serrata*), while in Bulletin 96 of the same Station Professor A. J. Cook discusses Honey Analyses.

Professor J. B. Smith has recently sent out two bulletins from New Jersey. In No. 95 he announces that Brood XII of the Periodical Cicada is due in New Jersey next year, and is likely to appear all over the state, though more abundantly in the northern and eastern counties. He suggests that no pruning or budding be done this fall or next spring, leaving abundance of surface for oviposition. This is an excellent example of the value of entomological prognostication.

Bulletin 94 discusses "Insects injurious to Cucurbs" in a practical way that is sure to be appreciated by New Jersey farmers.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—June 10, 1893.—Mr. Wm. T. Davis exhibited specimens of *Iva frutescens* and read the following paper upon "The Influence of the Past Winter on the High-Water Shrub."

An examination of the High-Water Shrubs, (*Iva frutescens,*) during the past few days, has disclosed an interesting fact, which is no doubt entirely due to the severe weather of the past winter. A glance along the meadow creeks show, as yet, but a gray line of bushes with numerous short sprouts starting either at their roots or a few inches above them on last year's wood. On the 7th of May, 1892, while observing the sea-side finches, the High-Water Shrubs were noticed to be coming into leaf midway up the stems, and by the middle of May it was difficult to secure a good view of the finches owing to the number of leaves. This year there would be no difficulty, for even at this date they are as bare as in the winter, having retained their vitality for only five or six inches above the ground. Some of the dead *Iva* stems show evidence of being three or four years old, so there is this proof also that the past winter has been the hardest one for the species during at least that length of time.

Mr. Davis also read the following: "Local Notes upon the Opossum and Red Fox."

The opossum visitation, which was commented upon in these Proceedings for March 12, 1892, has in no wise abated, and during the past year quite a number were killed on the island.

No less than fourteen opossums have been taken at Watchogue and the neighboring hamlets within a short period. It was thought by the residents, that they were possibly imported on the railroad, as the completion of the bridge and the appearance of the opossums were so nearly coincident. However, the causes given in the Proceedings referred to above, are probably the correct ones. In the winter of 1891–92, a dog owned by Mr. George Marsac, who lives at Watchogue, caught two opossums, one of them under the piazza floor. This past winter, Mr. Marsac and Mr. John De Bau found four opossums in a hollow gum tree; Mr. George Decker and Mr. Marsac caught two others, and Mr. Orville Merrill, one; Mr. George Merrill, one; Mr. Smith one in his cellar, and Mr. Van Pelt, who lives near Bull's Head, found one in his chicken house. Mr. Drake, of Old Place, heard a disturbance in his chicken house last summer, and discovered, upon investigation, an opossum, which he promptly killed. On April 30, 1892, I found a very much decayed opossum in the woods near Watchogue, and even under such circumstances it had the peculiar fatty odor for which the animal is remarkable.

Mr. Gratacap has informed me of an opossum captured on Bement Avenue, West New Brighton, and Mr. Galloway, of one killed on the Leonard White place, in Middletown. One was secured on the Mc Andrew place last winter ; one on the Meissner place at Richmond by Mr. Lyle, and one in the Moravian Cemetery by Mr. Albert.

This spring, Mr. Samuel Henshaw showed me a dead opossum under an apple tree near the brook that crosses the Manor Road ; Mr. Joseph C. Thompson found one near Arrochar, and Mr. Perry Cornell, on the 9th of April, caught a twelve pounder in the old iron ore mines on the slope of Todt Hill.

From the above facts and those presented in the Proceedings of March 12, 1892, it appears that the opossum has become well established on our Island, and that thirty-six individuals have been captured during the last four years. Of course, the record can only be considered as partly complete.

In connection with the opossum visitation, it may be well to record a few memoranda concerning the foxes that have been found on the island within the last few years. In 1887 or '88, one was killed by Mr. Cole, who resides on the Amboy Road, near Oakwood. It was believed at the time to be the individual that escaped from the superintendent of the railroad. In July, 1890, the *Richmond County Standard* printed an account of the foxes that had been killed or seen in the vicinity of Richmond. It was believed that the original pair either escaped from the hunters of the Country Club, or from the captain of a canal boat, which had several on board, while discharging his cargo of coal at Richmond Creek. The animals destroyed many fowls on the Dedker and Latourette farms, and on the former of these places a young fox was trapped, the jaws holding him by the toes. In the morning, it was found that his mother had evidently been busy all night, as his shoulders were lacerated by her efforts to secure his release. Another fox was shot by Mr. Decker, while it was killing a Guinea hen.

Last summer, Mr. Freemans of Old Place, was on the meadows near his home engaged with some companions in surveying, when they discovered a family of foxes beneath a hay stack. The male ran away upon the approach of danger, but the mother and five young were finally secured.

The following paper, by Mr. Arthur Hollick, in the absence of the writer, was read by the title "Notes on the Geology of the New Railroad Cut at Arrochar."

In a previous contribution on the Cretaceous formation of Staten Island, (Proc. Nat. Sci. Assn. S. I., Jan. 9, 1892), I mentioned the discovery of Cretaceous fossils at Arrochar, and called special attention to specimens of *Cardium dumosum* Conrad, which were found in a seam or stratum of sandy clay, which I was inclined to think might represent the outcrop of more extensive strata not far below. Recent excavations for a new railroad cut in the vicinity led me to hope that the overlying Drift deposits might be penetrated to a sufficient depth to expose these strata, which, from the surface indications, we know can not be very far away. Several visits were made while the work was in progress, but it was not until last week that the excavation was completed and, fortunately for the geologist, the heavy rain of the 6th inst. followed immediately afterward and washed everything clean in a most gratifying manner, affording unusually favorable conditions for final observation during the past few days.

At the base are masses or beds of bluish, semi-plastic and sandy clay, from which extend upward irregular seams and smaller masses, interbedded with fine sands and gravels, in which "flow and plunge" structure is generally well marked. This series of deposits reaches the surface at about where the new Arrochar station is located, and from thence southward are all that is to be seen. The bowlder till thins out to a feather edge where the sands and clays come to the surface and gradually become thicker northward, until finally it is all that is visible in the cut. The deepest part of the cut shows the entire series from base to summit and give us a 50 foot section in a N. and S. direction, through the extreme edge of the terminal moraine. Irregular masses of clay, accompanied by water-assorted sands and gravels at the base capped by the unassorted bowlder till on top. The thickening of the bowlder till northward and the position of the underlying materal give a general appearance of north to northwestward dip for the entire series.

No positive evidence of any Cretaceous strata in place could be found, but on the other hand a large part of the sands and gravels are manifestly reassorted Cretaceous material. The characteristic ferruginous sandy clay concretions in which most of our Cretaceous fossils have been found are abundant, and the sandy clay stratum in which the *Cardiums* previously mentioned were found, may be traced into the cut, with its accompanying sands and gravels. It can no longer be regarded as an outcrop, as other similar seams or masses are quite prominent, interbedded with the sands and gravels. In some places coarse gravel and clay nodules are so cemented together with limonite that a firm conglomerate is formed. Iron is everywhere abundant. In some hand specimens of the conglomerate may be seen pyrite, magnetite and limonite and spring waters are impregnated with the sulphate. Acc [illegible] tic iron sand may also been seen in places. Yellow Gravel or Pre-Glacial Drift is also, to a limited extent, a constitutent of the assorted material.

It is evident that only the upper part of the clay has been reached and this is very much disturbed and crumpled, portions having been torn off from the main mass below, forming the irregular beds or seams associated with the sands and gravels. The indications are that these were all deposited previous to the advent of the glacier which shoved them ahead and finally left them overlapped by the thin edge and flanked on the north by the mass of the bowlder till.

The character of the clay is not that of our ordinary bowlder clay, which is nearly always colored red from the prevailing constitutent—eroded Triassic sandstone and shale. These clays are bluish and the rock from which they were formed is not anywhere in evidence at the present time. The large amount of mica and the occasional fragments of mica schist, hornblende schist and granite which are to be found throughout all the underlying deposits at Arrochar may perhaps be accounted for on the theory of a belt of such rocks to the south and east of the serpentine ridge which has suffered decomposition and erosion and thus formed the source of supply for the bluish clay and micaceous fragments. Such a belt is theoretically present, for we know that it exists to the east of the serpentine at Tompkinsville and St. George. This theory is emphasized by the position of the clay which is beneath and older than the bowlder till and would thus have been formed independent of material from the red Triassic area which did not suffer extensive erosion until it had been overridden by the glacier. One lenticular basin of clay in the upper part of the till north of the morainal edge, deserves attention from the fact that the clay there formed is typical reddish bowlder clay, horizontally stratified and evidently undisturbed since its deposition, which must have been subsequent to the retreat of the glacier. This was the source from which the erstwhile brick yard at Arrochar obtained its material for the manufacture of building brick., The comparison between this red, horizontally stratified clay in the till above, and the bluish distorted masses beneath is striking.

One feature that will doubtless be noticed at once by everyone who examines the material in the moraine at Arrochar, is the quantity of soapstone and limonite ore contained in it, evidently due to the erosion of the serpentine ridge which near this point was crossed by the glacier.

Summarizing the results of our facts and observations we may picture to ourselves the former coastal plain, consisting of Cretaceous and later deposits, extending to the base of the serpentine ridge, with a belt of schistose or gneissic rocks around its base. On the advent of the glacier, advancing from the northwest these deposits were eroded and pushed ahead by the ice mass and assorted by the torrents which flowed from it, and which, on its retreat, left the deposits of the till, forming a superficial unassorted cap, composed of fragments of rocks from the north, in which the Triassic sandstones, shales and traps of New Jersey are the most abundant constituents. In the depressions of the till, local deposits of gravel, sand and clay would accumulate, colored with the prevailing red from the eroded Triassic rocks.

September, 9.—Dr. N. L. Britton showed a specimen of *Agrimonia mollis* as an addition to the flora of the Island. This and the commoner *A. striata*, have been included in manuals under *A. eupatoria* which is, however, a European species.

Mr. Arthur Hollick presented a piece of Triassic sandstone, found in the Drift at Arrochar, by Miss Grace Hollick, on which were casts of a plant stem.

Although Triassic shale and sandstone were among the most abundant of our Drift material this is the first specimen in which we have been able to identify any indication of a fossil. A carefully prepared drawing was submitted to Professor Lester F. Ward, palæobotanist of the U. S. Geological Survey, and was by him submitted to Professor Wm. M. Fontaine, who concluded that it was probably *Equisetum rogersi* Schimp. If so this is not only an interesting addition to our list of Drift fossils but is of interest also on account of its rarity in the Triassic of New Jersey, from whence it must have been derived. So far as I know New Milford is the only locality in New Jersey from which it has been reported.

Mr. Wm. T. Davis read the following miscellaneous memoranda and exhibited the specimens mentioned.

During the past summer the Periwinkle (*Littorina litorea*) has been found in some numbers alive on the shore at the Narrows, and also on the rocks at Princes Bay. In these Proceedings for January 14, 1888, Mr. Sanderson Smith, upon the finding of an empty shell at the Narrows by Mr. Hollick, gave an account of the southward migration of the species along the Atlantic Coast, noting its occurrence on Long Island, etc. This is the first record of its being found alive on our Island.

Mr. Leng recently collected in Augur Lake, near Keeseville, N. Y., a rare *Dytiscus* beetle, probably *D. harrisii*, which he brought home alive in a tin can as his alcohol bottle was not sufficiently large. Upon opening the can for the inspection of the insect, we were pleased to find a dark brown *Gordius* worm of unusual size. After carefully untwisting and unkotting the tangled creature, which took our united efforts, we measured it with a rule, and discovered that it was twenty-eight inches long. In Dr. Packard's zoology it is stated that hair-worms "live in ground-beetles and locusts," twisting around the intestines of their hosts.

The severe storms of the 24th and 29th of August blew many green hickory nuts from the trees, and in spite of their unripe condition the shell-bark nuts were promptly devoured by gray squirrels. Under one of the trees on Richmond Hill, there were many quarts of the outer green husks gnawed fine, and of the nuts from which the kernel had been extracted after the outer bitter covering had been wholly or in part removed. It appears from this that it is probably the firmness of their attachment to the end of the tree branches, and not their green husks, that prevent the unripe hickory nuts from often being eaten by squirrels.

This morning a green example of the walking-stick insect (*Diapheromera femorata*) was found in the Clove Lake swamp on a golden rod. Though common northward, in the Hudson River valley, it is rare with us, and this is only the fifth recorded specimen from our Island.

Mr. Davis also exhibited some exotic water plants that had been introduced by some person of an experimental turn into one of the numerous small ponds in the woods north of the Moravian Cemetery. Among them was the Chillian Mermaid-weed, the South American Pond weed (*Eichornia crassipes*), a lily and one of the sedges, all of which seem to do well among the native plants.

Boston Society of Natural History.—November 1st.—The following paper was read:

Professor George Lincoln Goodale, " On the cultivation of Tea, Coffee and Cacao. Illustrated by stereopticon views of plantations in Ceylon and Java.—Samuel Henshaw, *Secretary*.

The Biological Society of Washington.—October 21. The following communications were read:

Professor Lester F. Ward, "Weismann's Concessions." Doctor C. Hart Merriam, "Notes on a Biological Reconnoisance of Wyoming." Mr. Vernon Bailey.

November 4th.—The following communications were read:

Mr. W. T. Swingle, "Some Problems of Plant Geography in Florida." Doctor C. Hart Merriam, "Fauna and Flora of Eastern Wyoming." Doctor C. W. Stiles, "Artificial Species of Cestodes." Professor Lester F. Ward, "Cycadean Trunks in the American Cret. aceous."—FREDERIC A. LUCAS, *Secretary*.

NATIONAL ACADEMY OF SCIENCE.—The following papers were entered to be read at the meeting held at Albany, N. Y., November 7th, 1893.—I. American Palæozoic Cockroaches, Samuel H. Scudder. II. Additional Researches on the Motion of the Earth's Pole, Seth C. Chandler. III. Biographical Memoir of A. H. Worthen, C. A. White IV. Biographical Memoir of W. P. Towbridge, C. B. Comstock. V. The Geological Map of the State of New York, James Hall. VI. On a new form of Telescopic Objective, as applied to the twelve-inch Equatorial of the Dudley Observatory, Charles S. Hastings. VII. On the Structure and Development of Trilobites, Charles E. Beecher, (Introduced by A. Hyatt.) VIII. Double Stars, Asaph Hall. IX. Latitude Determinations at the Sayre Observatory, Charles L. Doolittle, (Introduced by Lewis Boss.) X. Insect Voices, Joseph A. Lintner, (Introduced by James Hall.) XI. Edible and Poisonous Fungi, Charles H. Peck, (Introduced by James Hall.) XII. A New Process of Printing in Color, Edward S. Morse. XIII. On Reaction—Times and the Velocity of the Nervous Impulse, J. McKeen Cattell and Charles S, Dolley, (Introduced by G. F. Barker.) XIV. The Palæontology of the State of New York; the present condition of the work, James Hall. XV. Certain Histological Relations Between the Subalpine Plants of the White Hills and of the Labrador Coast, George Lincoln Goodale.

A special stated session of the Academy took place on Wednesday, November 8th, in Albany, to consider the President's Annual Report to Congress, and other business.

The new Dudley Observatory was dedicated. Prof. Newcomb made the speech for astronomy and there were other speeches by Mr. Lansing and Bishop Doane, Gen. Rathbone was master of ceremonies.

SCIENTIFIC NEWS.

The Natural History Society of Dantzic offers a prize of 1250 francs for the best essay on the most efficacious means of destroying the poisonous insects in the forests of western Prussia. The essays must be written in German or French and be sent to the Society before the end of 1898.

Professor Loew, of Munich, has been elected to the chair of Chemical Argriculture in the University of Tokio. Professor Loew is well known from his researches on the nature of protoplasm.

Dr. H. Möller has been appointed Professor of Botany in the University of Greifswald.

An exploring and surveying expedition has been organized in Brazil to study the less known parts of the Amazon basin and to collect information as to ethnography and natural history. The expedition was intended to leave Santos in August, and cross the plateau of Matto-Grosso towards the upper waters of the Amazon, where surveys and scientific collections will be made.

The California Academy of Sciences has published a bibliography of the Paleozoic Crustacea, prepared by Mr. A. W. Vogdes. Besides the list of authors there is an index of the species described in each work. The literature ranges from 1698 to 1892.

Erratum.—Through an oversight on the part of the engraver the figures (Plates XIX–XX) accompanying the paper on "Eggs of Pityophis melanoleucus," in the October NARURALIST, were reduced one-quarter, while the accompanying legends were printed as in the original copy. The error neeessitates the substitution of the following for the table of explanations on page 885, and corresponding corrections in the legend subscribed to each figure.

EXPLANATIONS OF PLATES XIX, XX.

Pityophis melanoleucus.

Fig. 1—Cluster of seven eggs represented as they naturally cohcre. a—point at which an eighth egg was attached.; ¾ natural size.

Fig. 2—Surface cracking of the calcareous crust—from an equatorial region; x 7½.

Fig. 3—Vertical section of a small portion of the egg shell showing a small part of five laminæ; x 600.

Fig. 4—Several fibres of different sizes after being dried and mounted in glycerin. The lumens are filled with air; x 600.

Ftg. 5—Surface view of a small portion of a lamina; x 127.

Fig. 6—A few isolated fibres. x 375.

Fig. 7–8—Two views of embryos in their natural positions on the yolk; ¾ natural size.

Fig. 9—Left side of head of an embryo showing the scutes. x 5¼; p. 881.

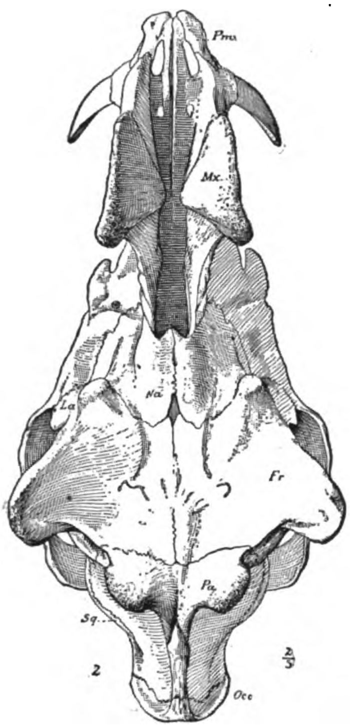
Fig. 10—Dorsal view of the same; x 5¼; p. 881.

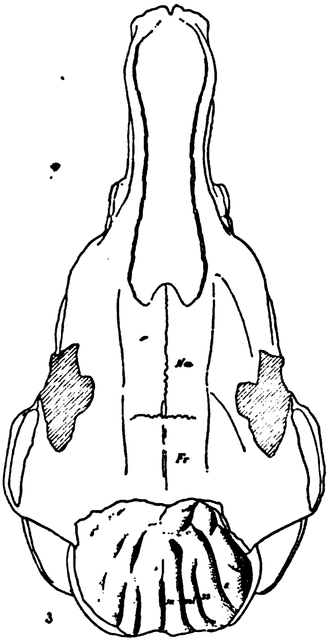
Fig. 11—Anal plate and hemi penes of a male; x 6.

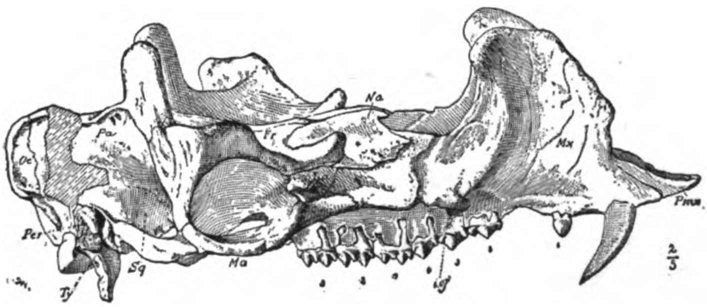
Fig. 12—Same region of a female; a—rudimentary hemi penes; x 6.

Fig. 13—Lateral (external) view of a hemipenis; x 5¼.

PLATE I.

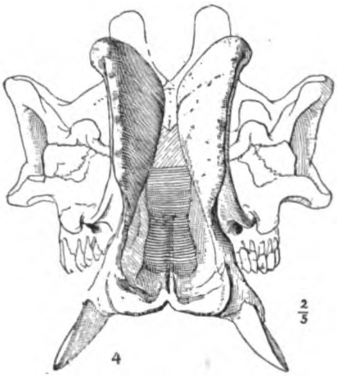




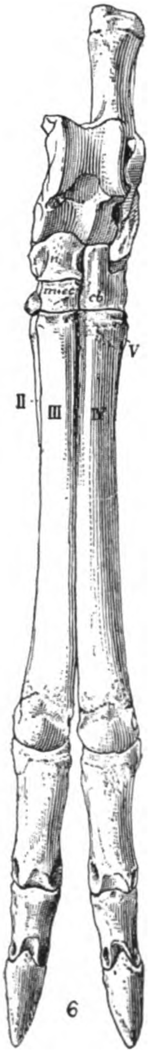


Protoceras celer Marsh.

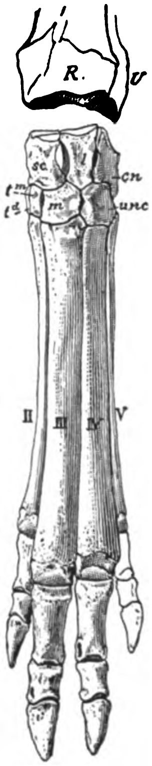
PLATE II.



4



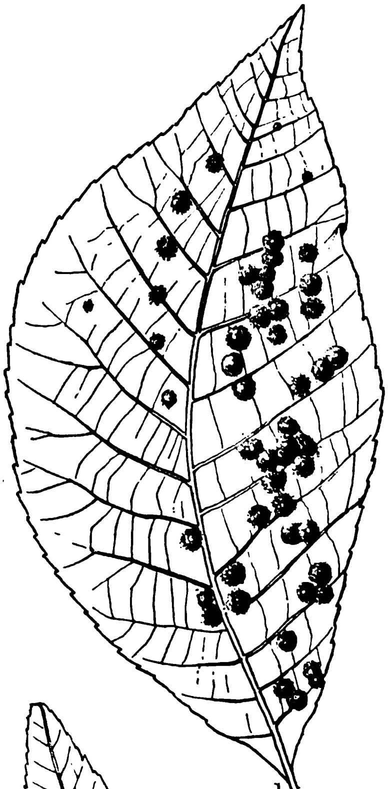
6

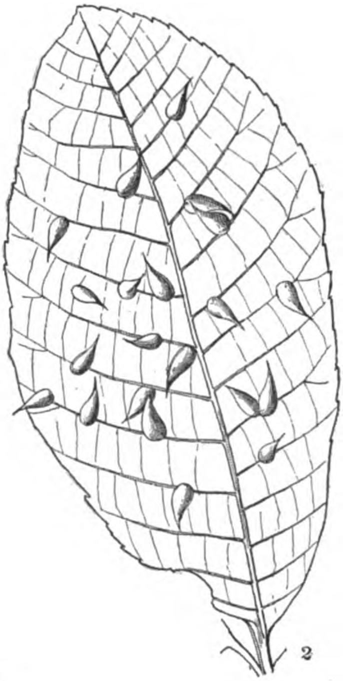


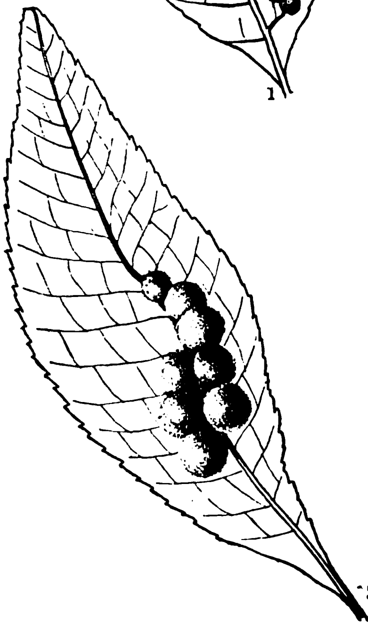
5

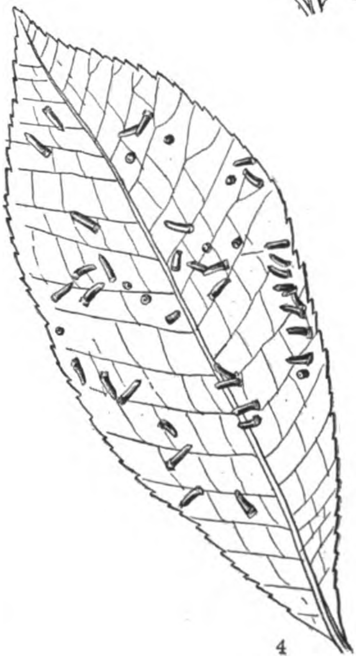
Protoceras celer **Marsh.**

PLATE III.


1

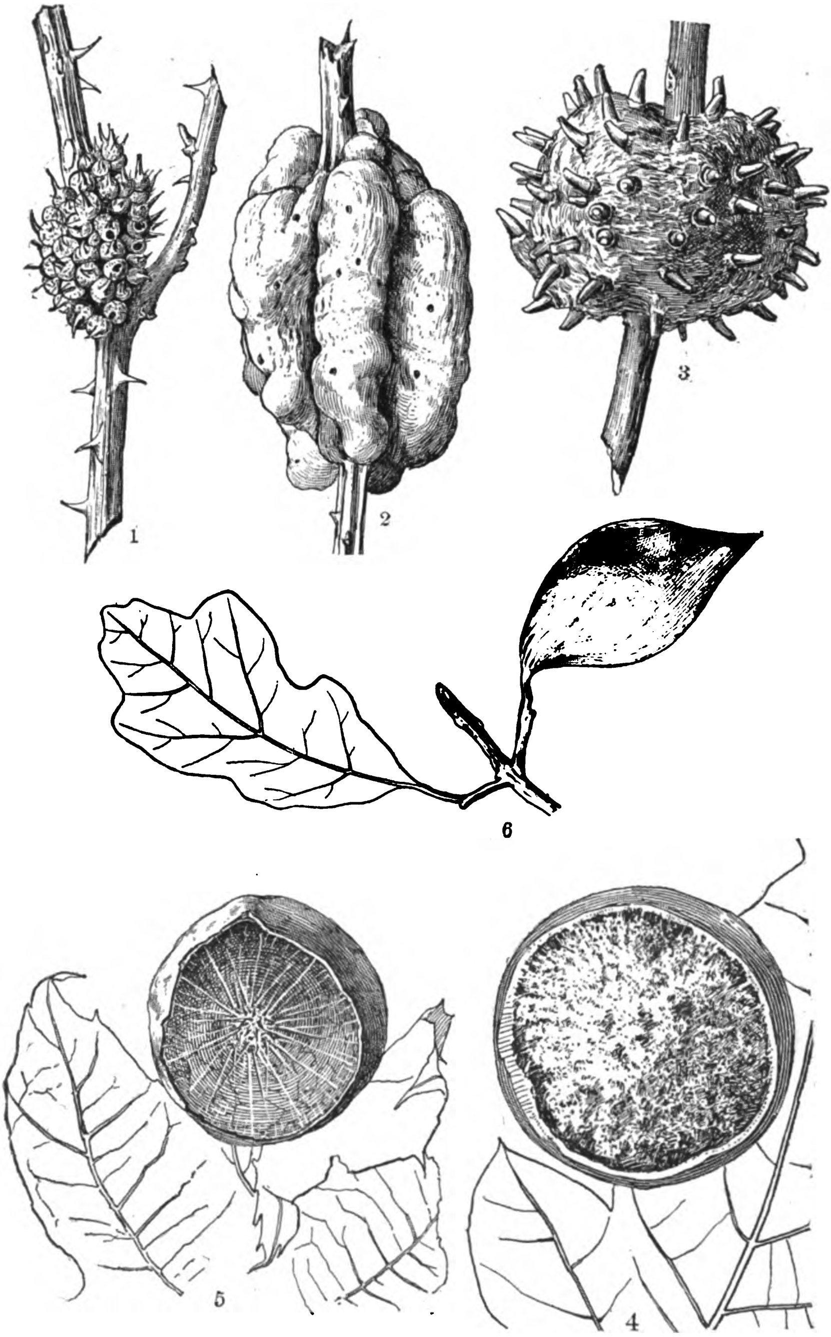

2


3


4

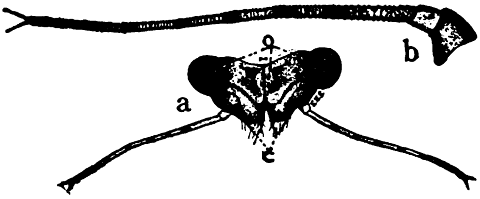
1. *Cecidomyia holotricha* O. S.
2. *Cecidomyia caryæcola* O. S.
3. *Cecidomyia persicoides* O. S.
4. *Cecidomyia tubicola* O. S.

PLATE IV.

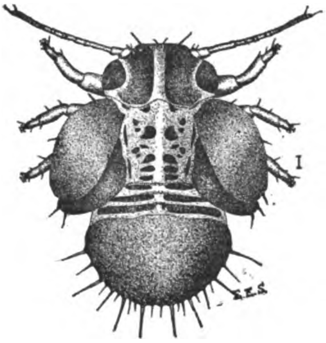


1. *Diastrophus cuscutæformis* O. S.
2. *Diastrophus nebulosus* O. S.
3. *Andricus cornigerus* O. S.
4. *Amphibolips confluentus* Harr.
5. *Amphibolips inanis* O. S.
6. *Amphibolips ilicifoliæ* Bass.

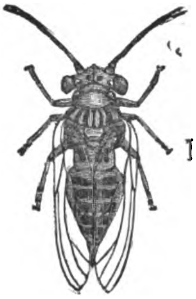
PLATE V.



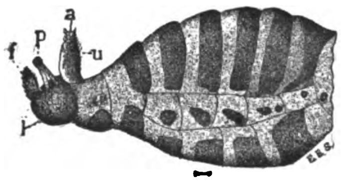
2.



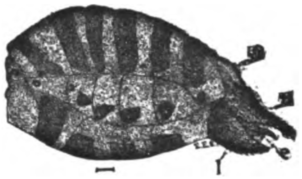
6.



1.

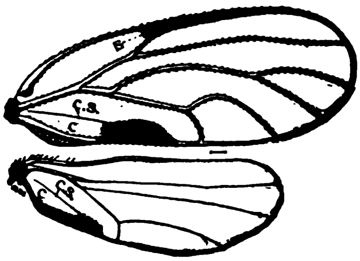


3.



4.

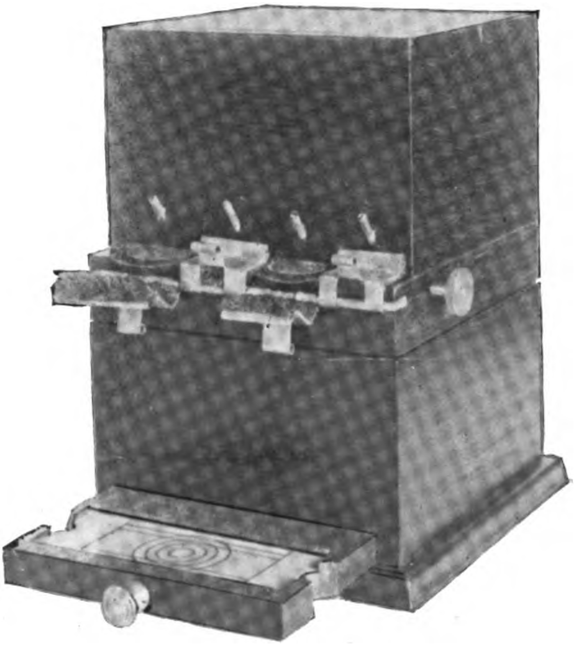
7.



5.

The Pear Tree Psylla.

PLATE VI.



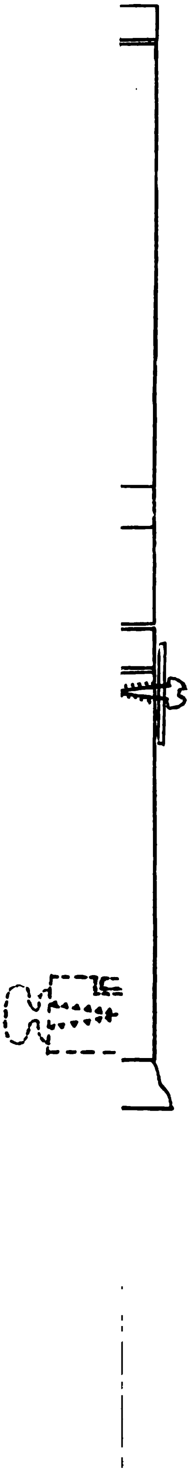
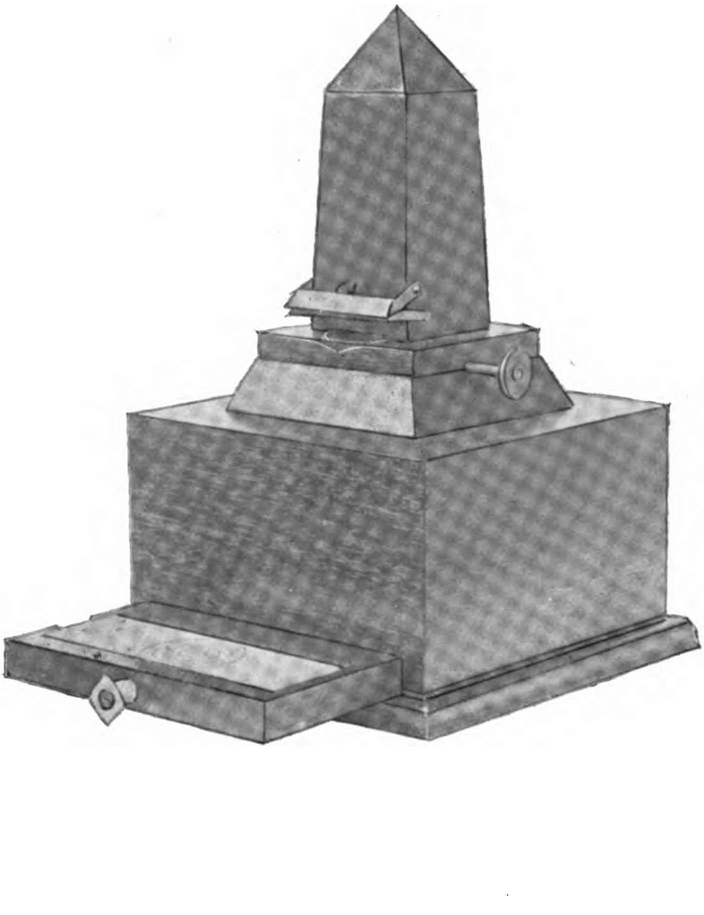
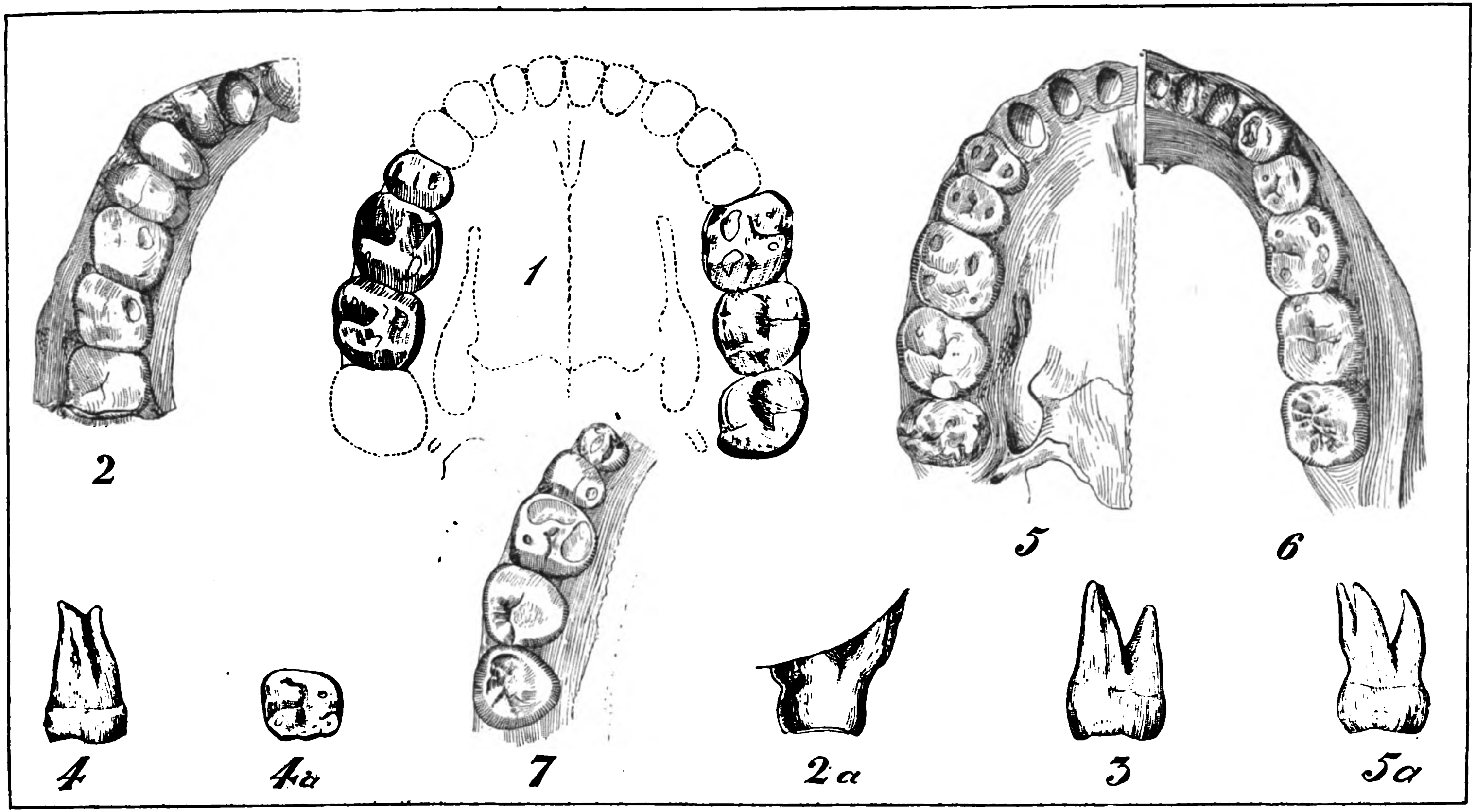


PLATE VIII.



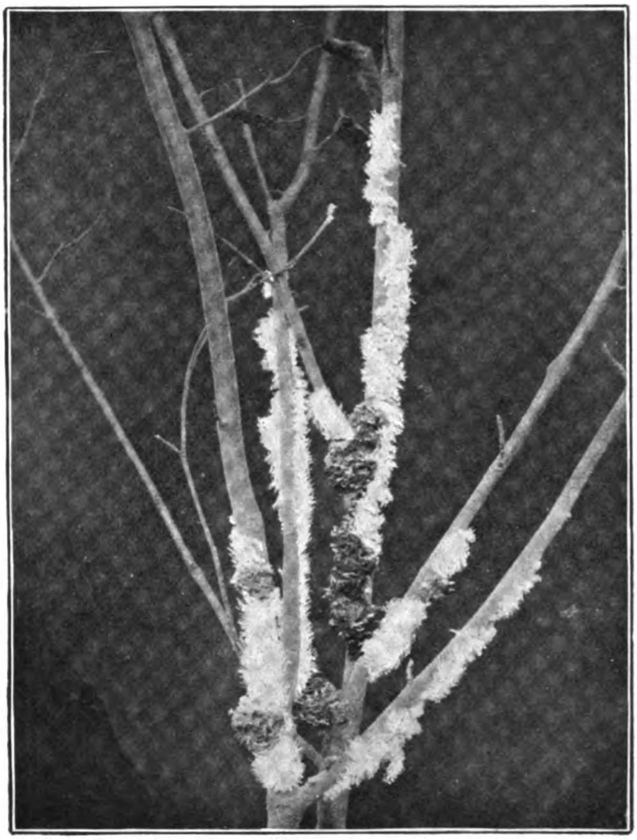
Digitized by Goo[redacted]

PLATE IX.



1–2. *Man and Woman of Spy.* 3. *Maori.* 4. *Tahitian.* 5–6. *Fan.* 7. *Esquimaux.*

PLATE X.



The Woolly Alder Aphis.

PLATE XI.

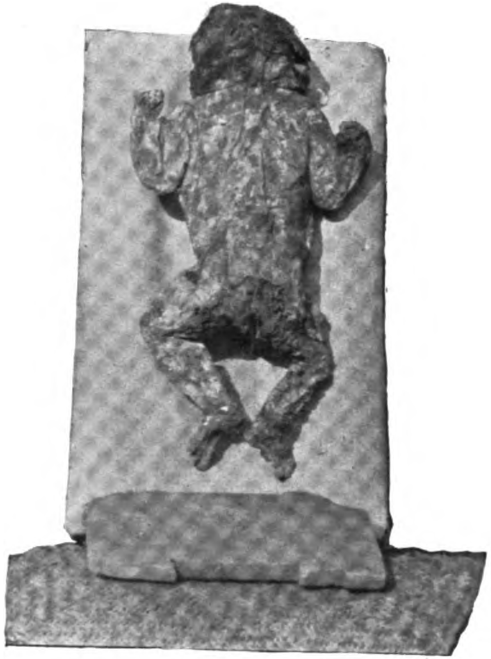


Fig. 1.

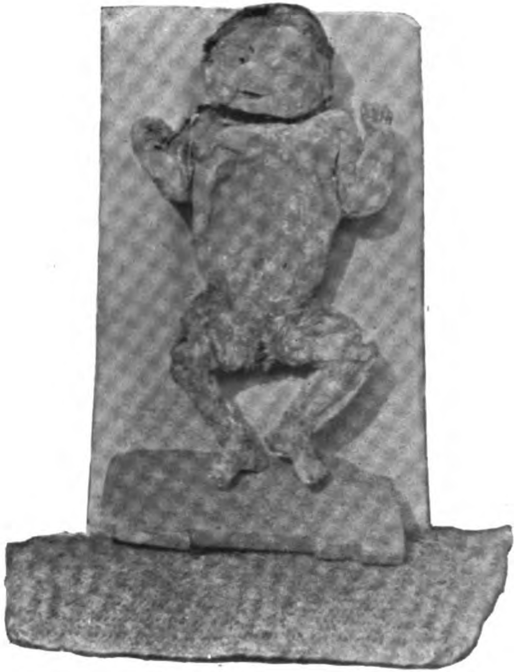


Fig. 2.

Mummied child from a Cliff-dwelling.

PLATE XIII.

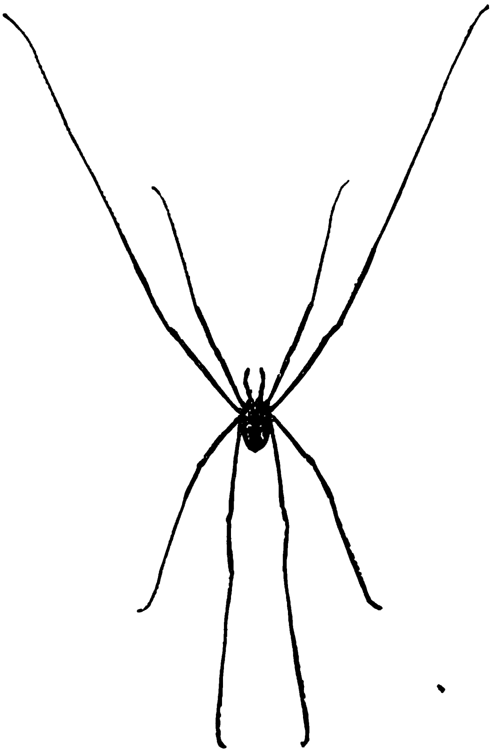


FIG. 1.

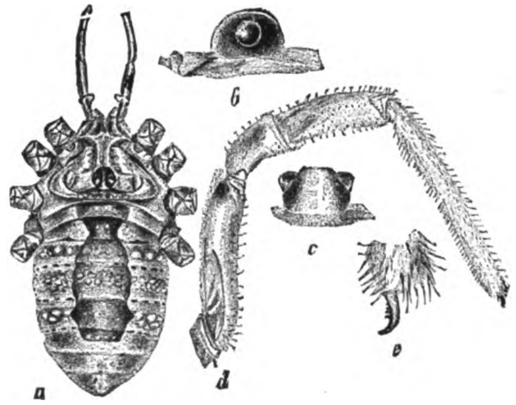


FIG. 2.

Liobunum ventricosum hyemale Weed. Immature.

PLATE XIV.

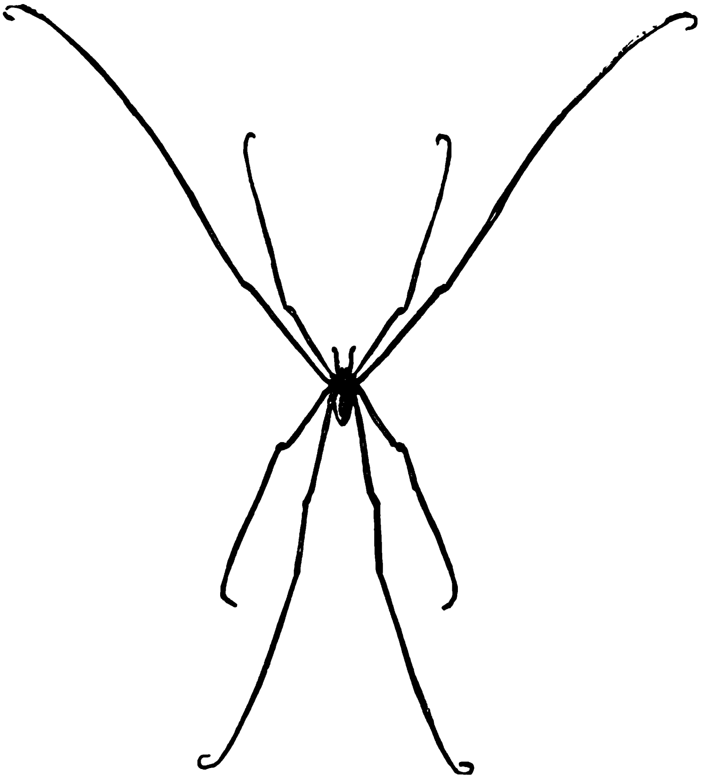


FIG. 1.

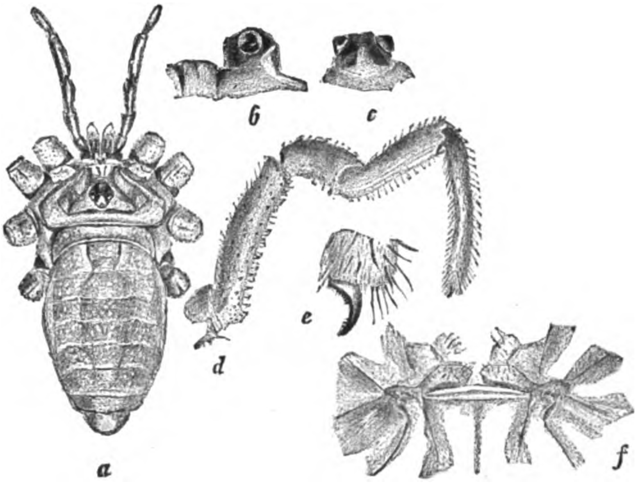
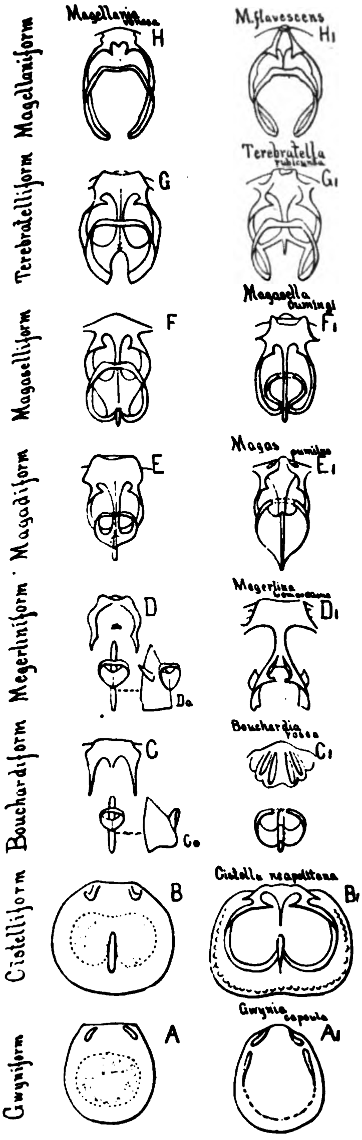


FIG. 2.

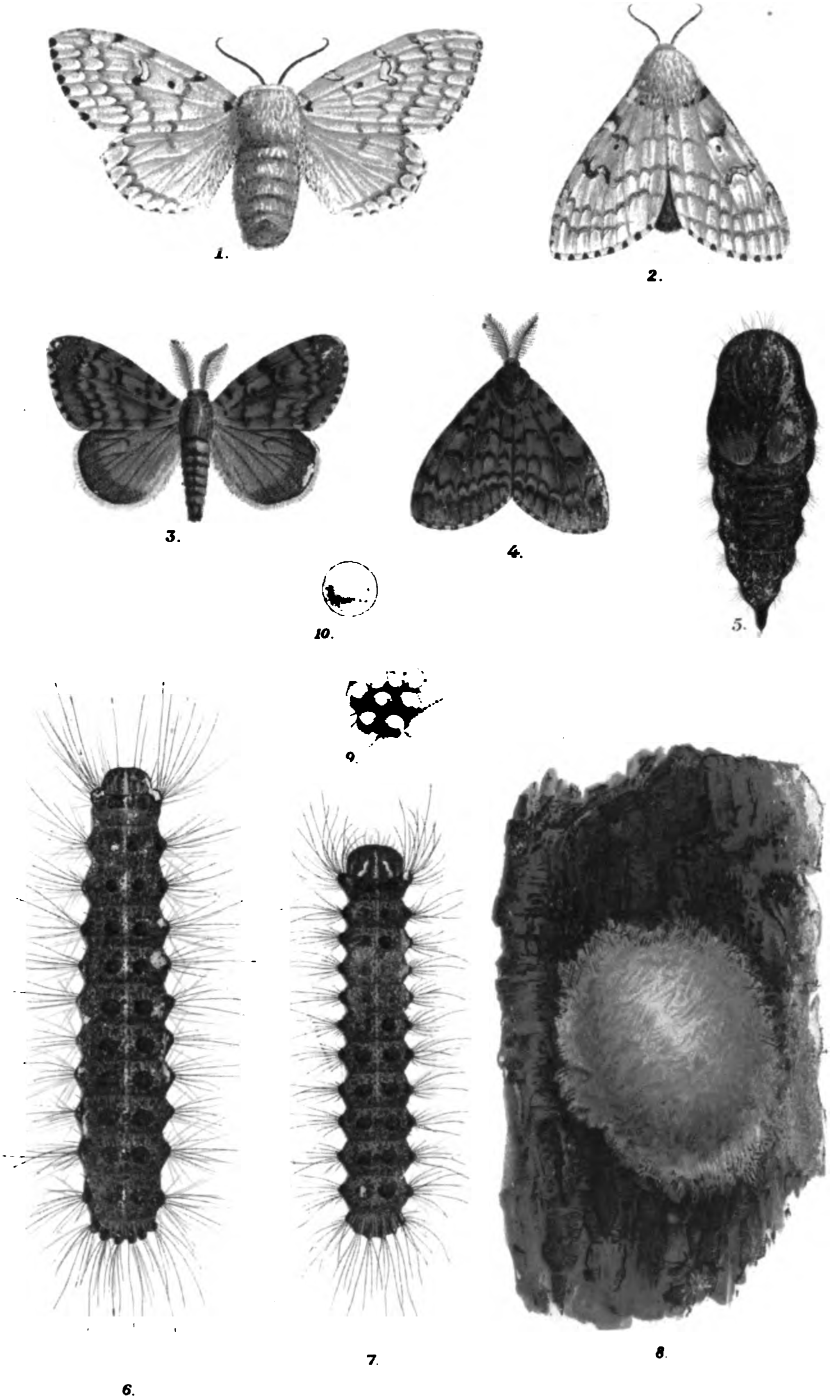
Liobunum ventricosum (Wood.)

PLATE XV.



Parallelism in Brachiopoda, (Magellania series.)

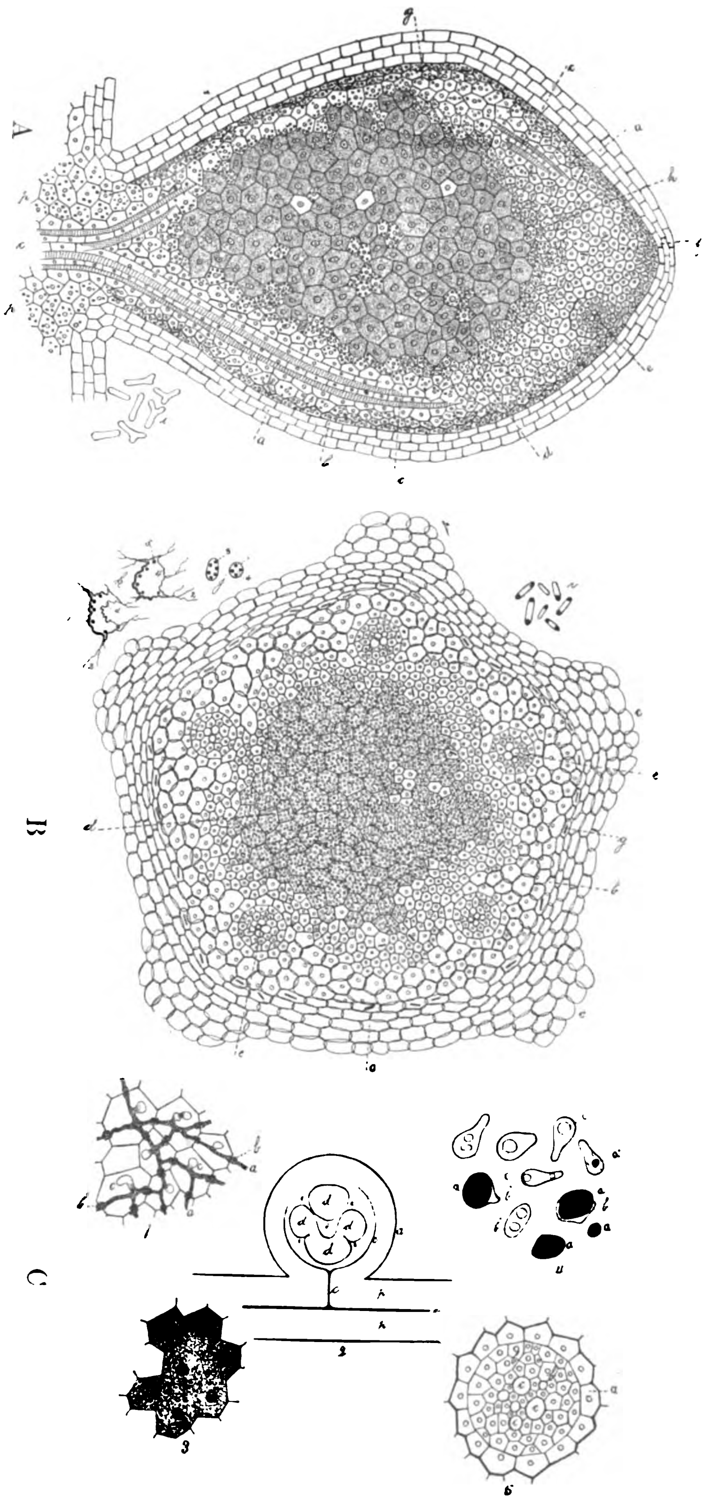
PLATE 17. [redacted]



Drawn by Joseph Bridgham. Heliotype Printing Co. Boston.

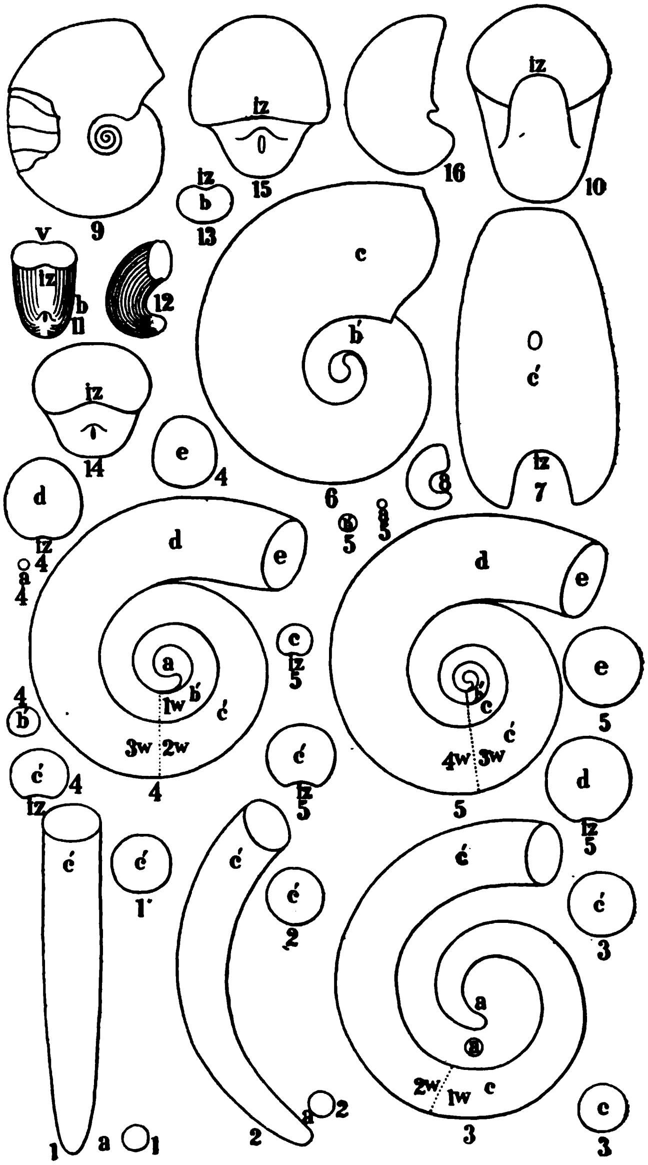
GYPSY MOTH.

PLATE XVII.



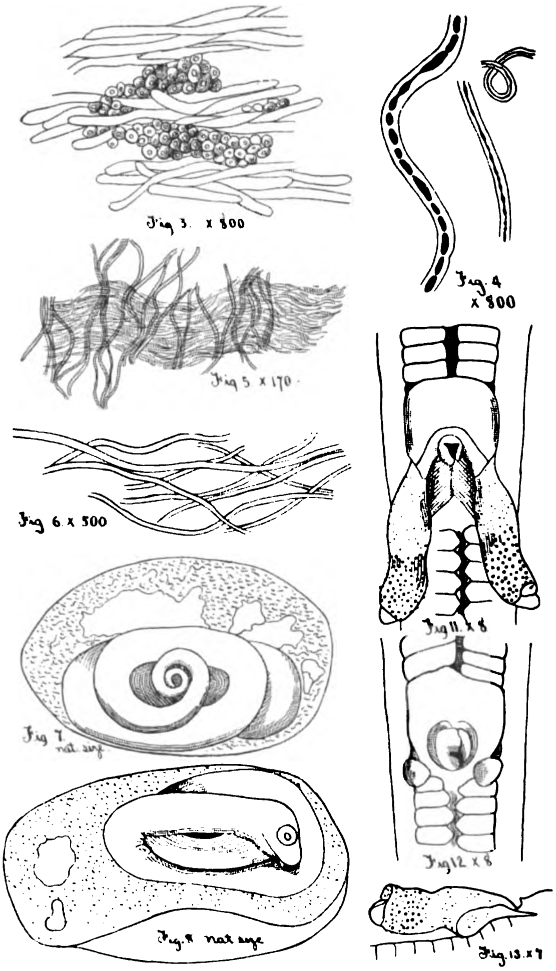
Root Tubercles of Leguminosæ.

PLATE XVIII.



Hyatt on Cephalopoda.

PLATE XIX.



Pityophis melanoleucus.

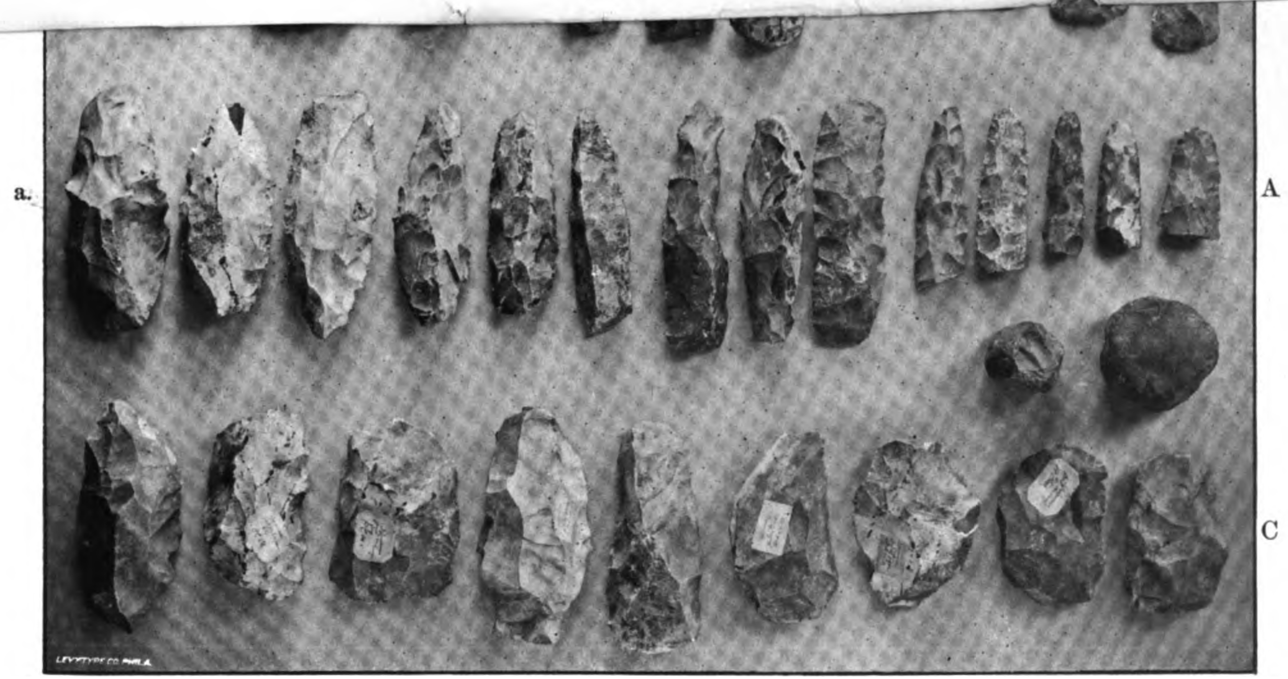


FIG. 6.

Series of specimens from the Neolithic quarry at Spiennes (near Mons, Belgium.)

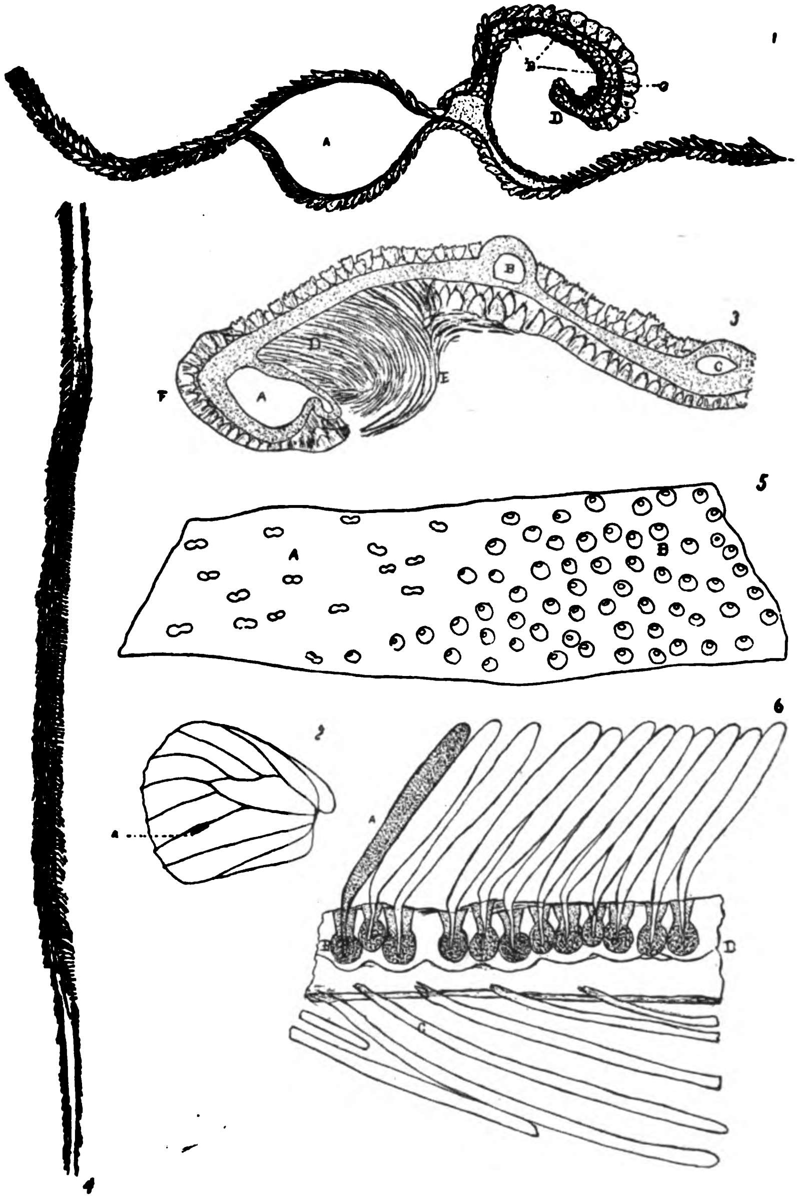
A. Results. Long thin blades worked toward a point.

B. Results. Chipped Celts—Round cutting edge specialized.

a. Blocked out forms tending toward class A. b. Blocked out forms tending toward class B.

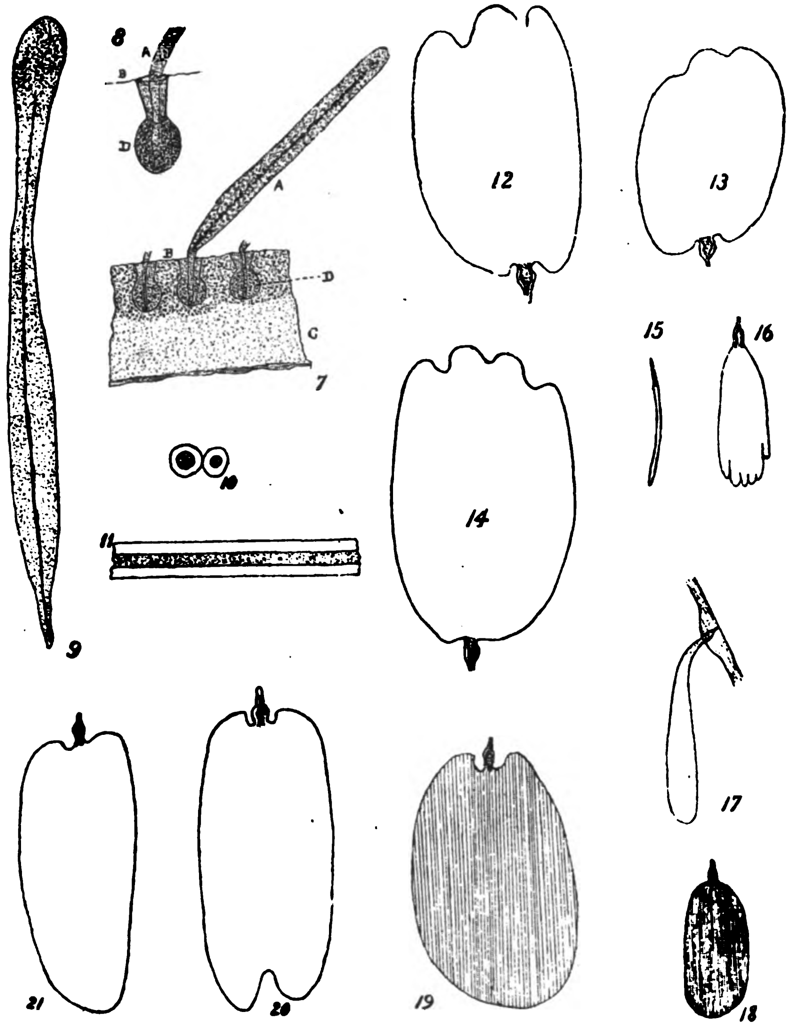
C. Hammerstones and inchoate masses, intent indeterminable, often resembling the ruder forms from Abbeville, American quarry refuse, and Trenton specimens.

PLATE XXII.



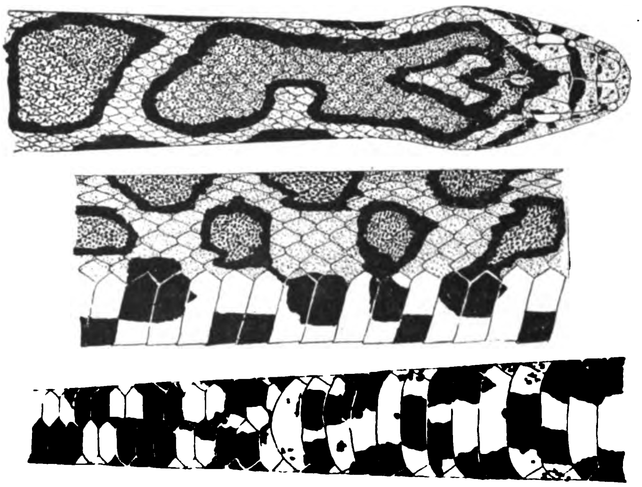
Androchonia of Lepidoptera.

PLATE XXIII.



Androchonia of Lepidoptera.

PLATE XXIV.



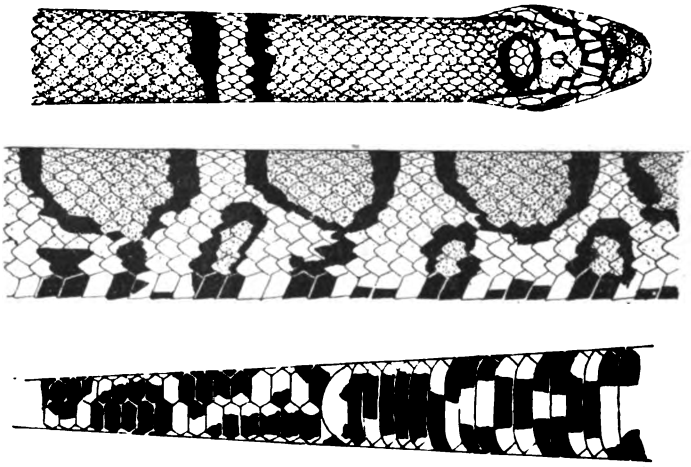
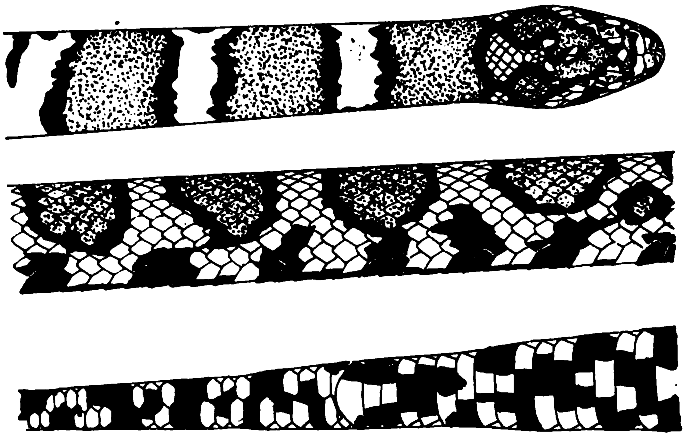


Fig. 1. *Ophibolus doliatus triangulus.*

Fig. 2. *Ophibolus doliatus clericus.*

PLATE XXV.



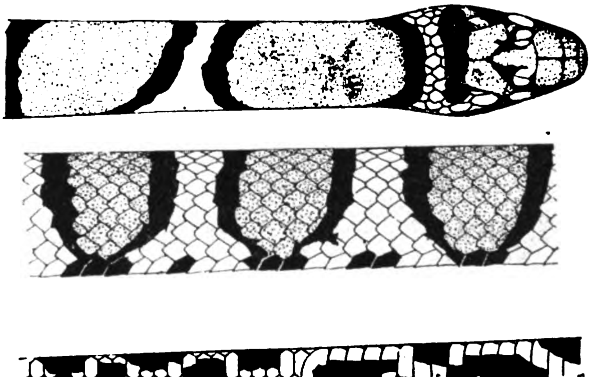
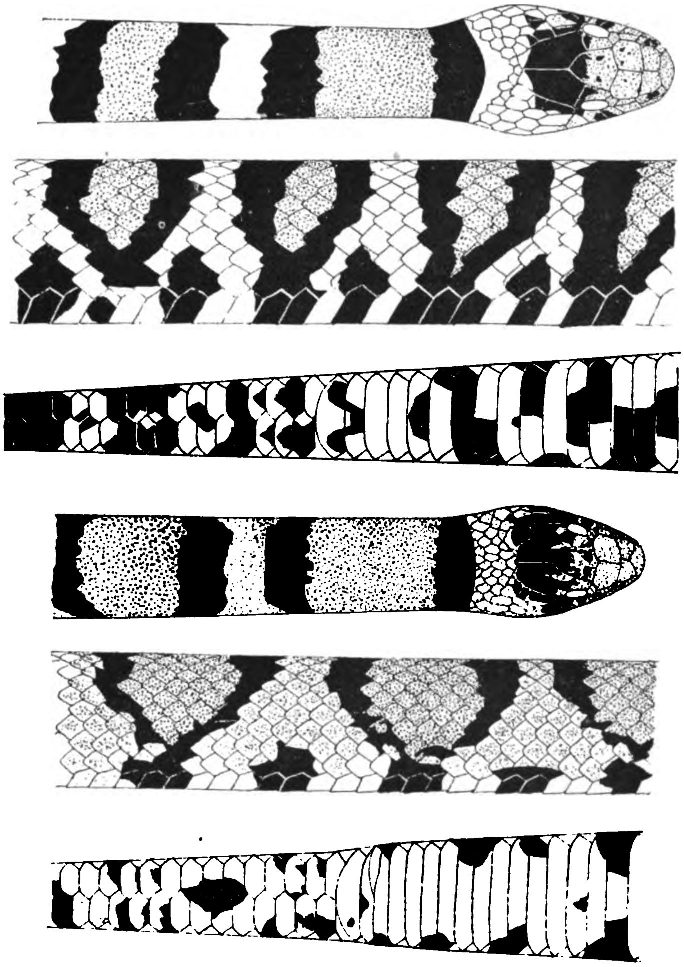


Fig. 3. *Ophibolus doliatus collaris.*

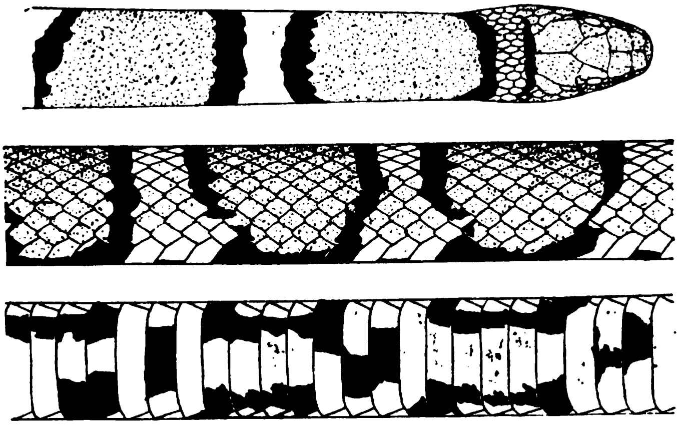
Fig. 4. *Ophibolus doliatus temporalis.*

PLATE XXVI.



Figs. 5–6. *Ophibolus doliatus doliatus.*

PLATE XXVII.



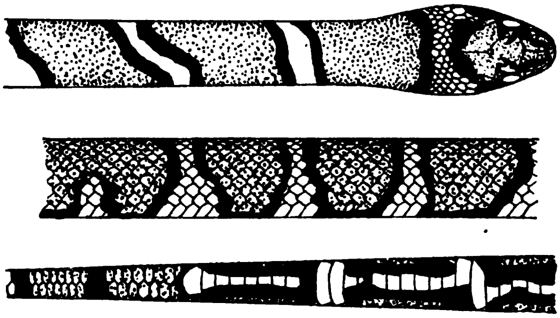
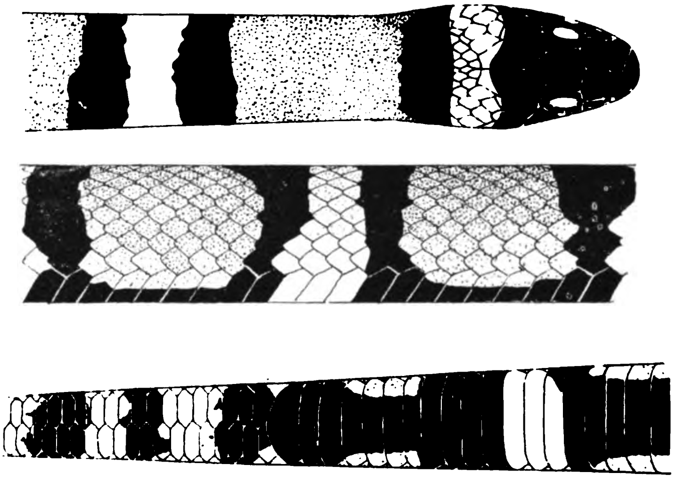


Fig. 7. *Ophibolus doliatus syspilus.*

Fig. 8. *Ophibolus doliatus parallelus.*

PLATE XXVIII.



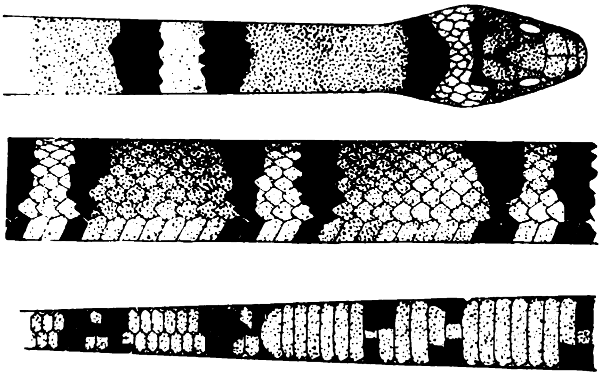
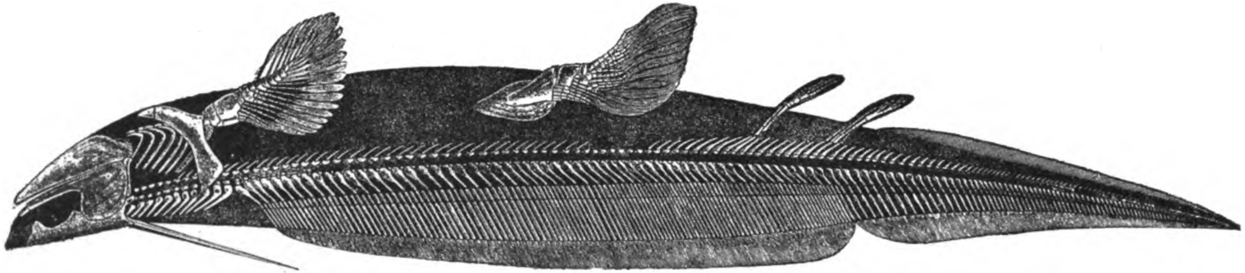


Fig. 9. *Ophibolus doliatus annulatus.*

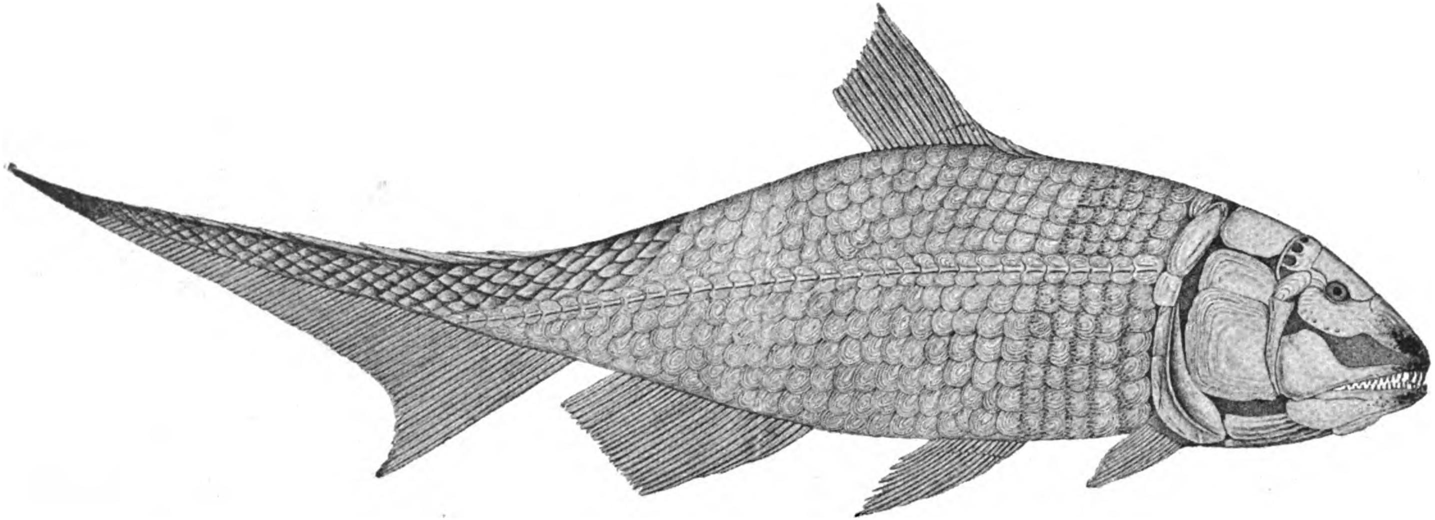
Fig. 10. *Ophibolus doliatus coccineus.*

PLATE XXIX.

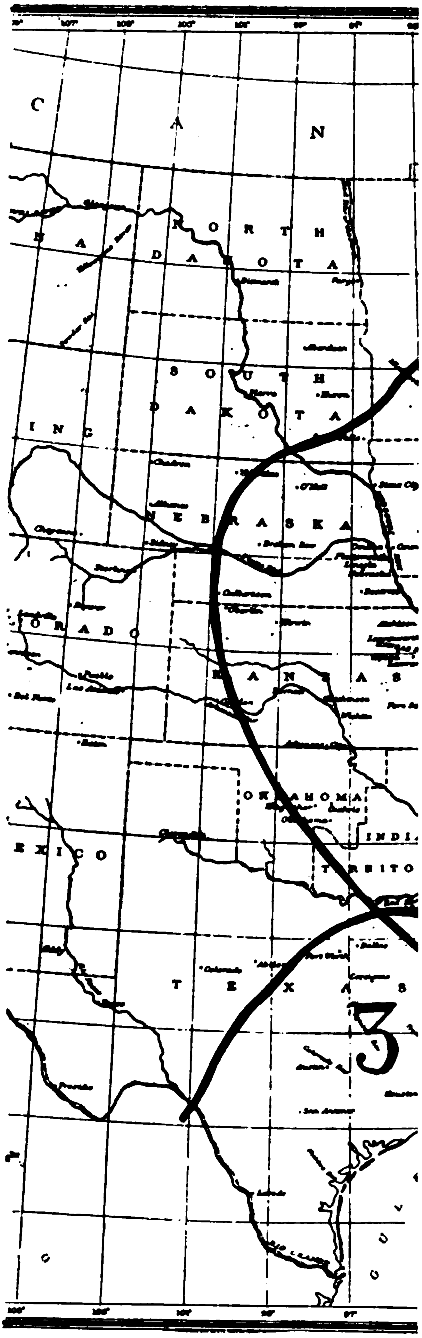


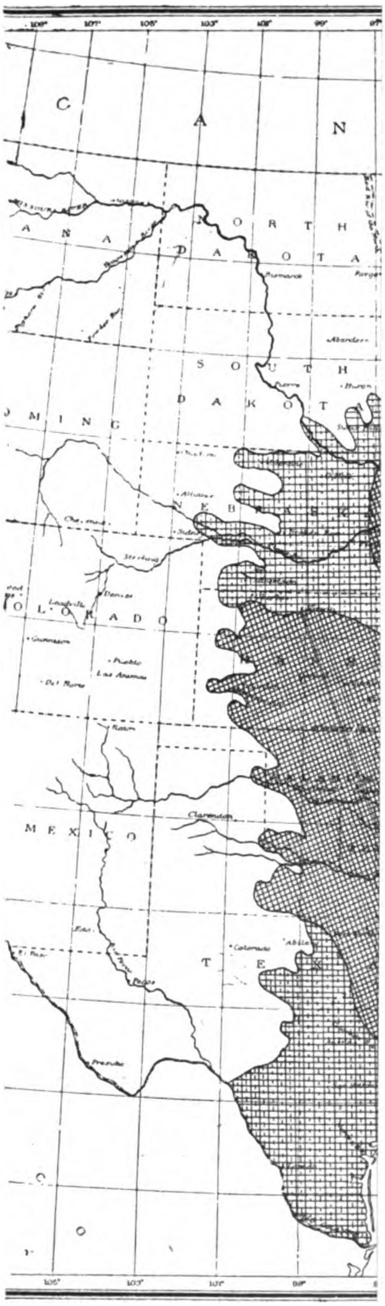
Xenacanthus dechenii Goldf.

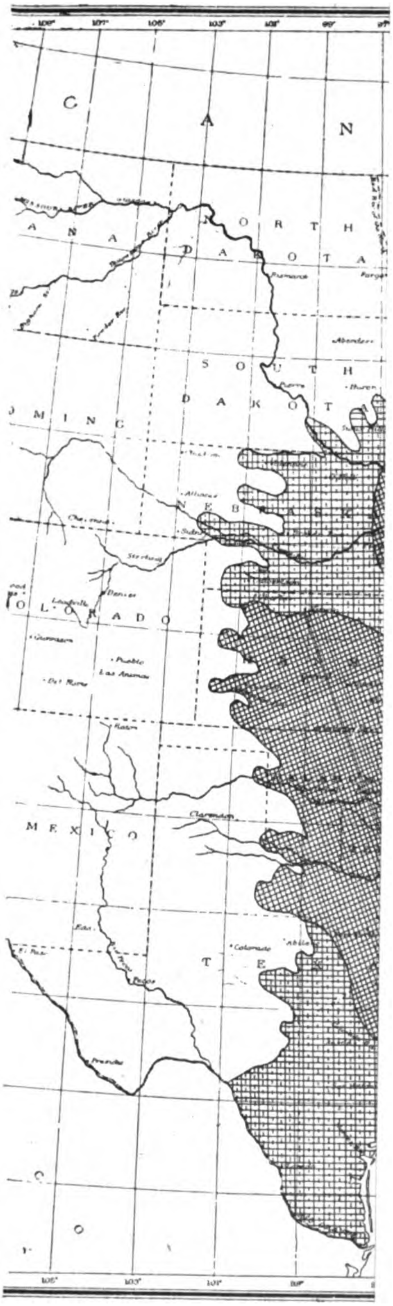
PLATE XXX.

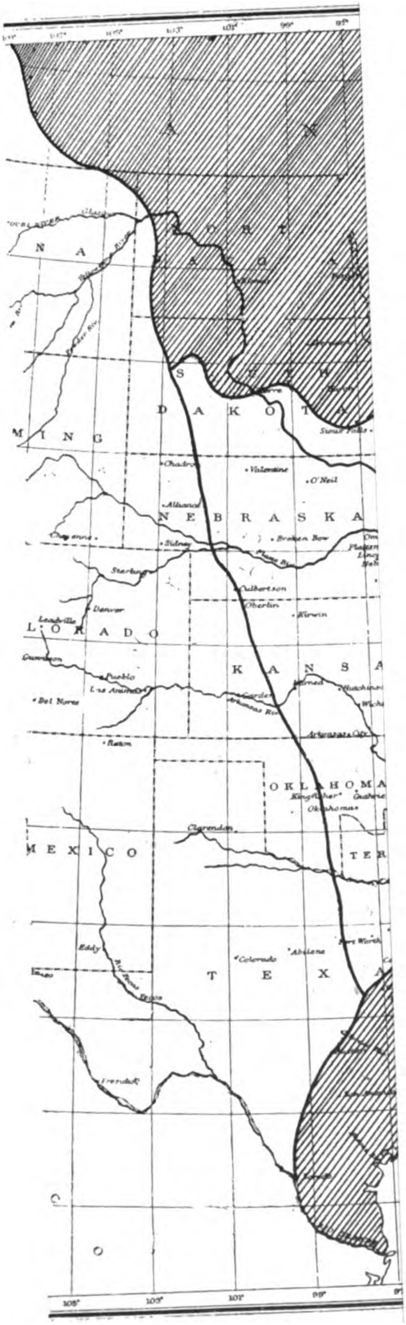


Trissolepis kounoviensis Fritsch.


C
A
N
NORTH DAKOTA
Bismarck
Fargo
Aberdeen
SOUTH DAKOTA
Pierre
Huron
ING
Chadron
O'Neill
Alliance
NEBRASKA
Cheyenne
Sidney
Broken Bow
Lincoln
Sterling
Culbertson
Oberlin
Denver
Leadville
ORADO
Pueblo
Las Animas
Raton
KANSAS
Hutchinson
Wichita
Arkansas City
Atchison
Leavenworth
Fort Scott
OKLAHOMA
Guthrie
INDI
TERRITO
EXICO
Dallas
Fort Worth
Corsicana
Abilene
Colorado
TEXAS
3
Austin
San Antonio
Houston
Presidio
Laredo
Rio Grande

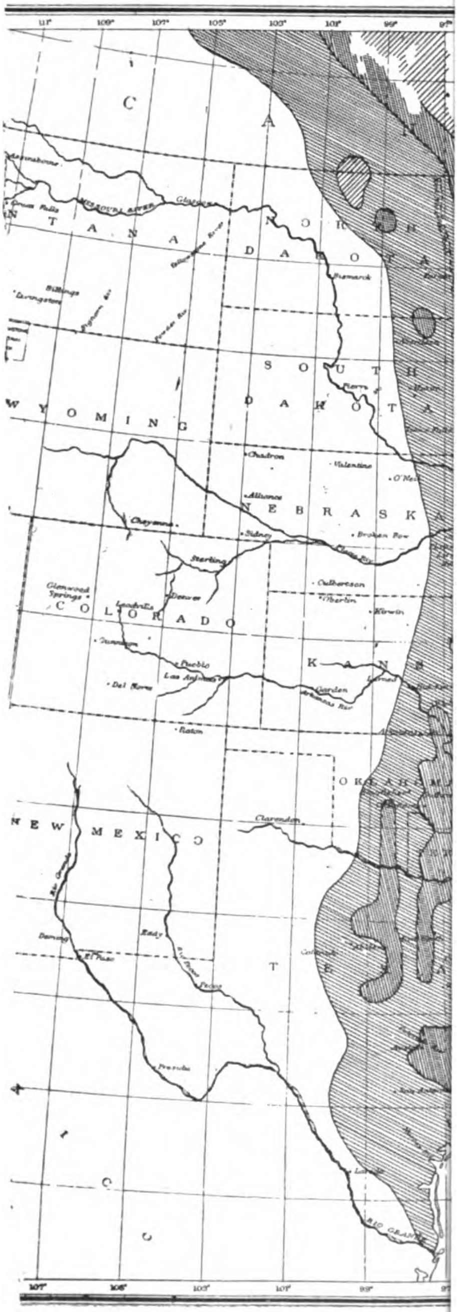

109°
107°
105°
103°
101°
99°
97°
CAN
ANA
NORTH DAKOTA
Bismarck
Fargo
Aberdeen
SOUTH DAKOTA
Pierre
Huron
MING
NEBRASK
Alliance
Cheyenne
Sterling
Denver
Leadville
COLORADO
Gunnison
Pueblo
Las Animas
Del Norte
Raton
Clarendon
MEXICO
Colorado
Abilene
TEX
Pecos
El Paso
Presidio
105°
103°
101°
99°


109°
107°
105°
103°
101°
99°
97°
C A N
A N A
N O R T H
D A K O T A
Bismarck
Fargo
Aberdeen
S O U T H
D A K O T A
Pierre
Huron
M I N G
N E B R A S K
Alliance
Sidney
Cheyenne
Sterling
Denver
Leadville
O L O R A D O
Gunnison
Pueblo
Las Animas
Del Norte
Raton
M E X I C O
Clarendon
Colorado
Abilene
T E X
El Paso
Pecos
Presidio
C
O
105°
103°
101°
99°



105°
103°
101°
99°
97°
Glasgow
N A
N O R T H
D A K O T A
Pierre
Sioux Falls
S O U T H
D A K O T A
M I N G
Chadron
Valentine
O'Neil
Alliance
N E B R A S K A
Broken Bow
Cheyenne
Sidney
Sterling
Culbertson
Oberlin
Kirwin
Denver
Leadville
L O R A D O
Gunnison
Pueblo
Las Animas
Del Norte
K A N S A
Larned
Hutchinson
Garden
Arkansas R.
Arkansas City
Raton
OKLAHOMA
Kingfisher
Guthrie
Oklahoma
Clarendon
M E X I C O
T E R
Eddy
Colorado
Abilene
Fort Worth
T E X A
Pecos
105°
103°
101°
99°
97°

107°
105°
103°
101°
99°
97°
95°
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
INDIAN TERRITORY
TEXAS
COLORADO
WYOMING
NEW MEXICO
Glasgow
Bismarck
Fargo
Aberdeen
Pierre
Sioux Falls
Alliance
Cheyenne
Sidney
Broken Bow
Omaha
Council
Plattsmouth
Lincoln
Nebraska
Beatrice
Sterling
Denver
Culbertson
Oberlin
Kirwin
Atchison
Leavenworth
Topeka
Lawrence
Leadville
Pueblo
Las Animas
Del Norte
Garden
Larned
Hutchinson
Wichita
Fort Scott
Arkansas City
Raton
Kingfisher
Guthrie
Oklahoma
Clarendon
Dallas
Fort Worth
Abilene
Colorado
Corsicana
Eddy
Pecos
Presidio
Platte Riv.
Arkansas Riv.
Kansas Riv.
Missouri Riv.
Red Riv.
Paris
105°
103°
101°
99°
97°


111°
109°
107°
105°
103°
101°
99°
97°
C
A
N
Assiniboine
Great Falls
MISSOURI RIVER
Glasgow
N T A N A
Yellowstone River
Billings
Livingston
Bighorn Riv.
Powder Riv.
N O R T H
D A K O T A
Bismarck
S O U T H
D A K O T A
Pierre
W Y O M I N G
Chadron
Valentine
O'Neil
Alliance
N E B R A S K A
Cheyenne
Sidney
Broken Bow
Platte Riv.
Sterling
Culbertson
Oberlin
Kirwin
Glenwood Springs
C O L O R A D O
Leadville
Denver
Gunnison
Pueblo
Las Animas
Del Norte
K A N S
Larned
Garden
Arkansas Riv.
Raton
O K L A H O M A
Clarendon
N E W M E X I C O
Rio Grande
Eddy
Deming
El Paso
Pecos Riv.
Pecos
T E
Colorado
Presidio
Laredo
RIO GRANDE
M
I
C
O
107°
105°
103°
101°
99°
97°

0 per Year. $4.60 per Year (Foreign). 35 cts. per Copy.

248.1

3479.

THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

MANAGING EDITORS:
PROFS. E. D. COPE AND J. S. KINGSLEY.

JAN 13 1

ASSOCIATE EDITORS:
DR. C. O. WHITMAN,
PROF. C. M. WEED,
DR. C. E. BESSEY,
PROF. W. S. BAYLEY,
THOMAS WILSON,
PROF. E. A. ANDREWS.

l. XXVII. JANUARY, 1893. No. 313

CONTENTS.

PAGE.

GASES IN LIVING PLANTS. (To be continued.) *J. C. Arthur.* 1

TAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED. (To be continued.) (Illustrated) *Clarence B. Moore.* 8

ENDS OF THE SUMIRO-ACCADIANS OF CHALDEA. (To be continued.) . . . *Alice Bodington.* 14

FLIGHT OF BIRDS. (Illustrated.) *I. Lancaster.* 20

ORIALS.—The Antivivisectionists in Penn vania;—The Coming Peary Expedition;—Dates of issue of the Naturalist for 1892. . . 26

ENT BOOKS AND PAMPHLETS. 28

ENT LITERATURE.—The Apodidæ—Darwin, and After Darwin; I, The Darwinian Theory;—The Diseases of Personality. 31

ERAL NOTES.

eology and Paleontology.—On the Formation of ite—Geology of Northeastern Alabama—The osauria of South Africa—Kansas Pterodactyls—logical News, General—Paleozoic—Mesozoic—ozoic 34

Mineralogy and Petrography.—The Origin and ssification of Igneous Rocks—The Novaculites Arkansas—Petrographical News—A New Occur- ce of Ptilolite—Mineralogical News—Mineral Syntheses—New Minerals—Landauer's Blowpipe Analysis. 40

Botany.—A New Edition of Wolle's Desmids—Botanical Definitions—Timely Words as to the Nomenclature Question — Engler and Prantl's "Natürlichen Pflanzenfamilien." 47

Zoology.—Locomotion of Limpets—Tunicate Studies—The Skeleton and Teeth of the Australian Dugong—On the Cephalo-humeral Muscle and the So-Called Clavicle of Carnivora—A New Synaptomys from New Jersey—A New Evotomys from Southern New Jersey—Zoological News. . . . 51

Embryology.—Gastrulation of Aurelia—Cleavage in Aequoria Forskalea. 57

Entomology.—The Pupa of Argyramœba œdipus—The Horn-Fly in Canada and Texas—The Wheat Frit-Fly—Entomological Notes. 60

Psychology.—Notes on Habits of Certain European Birds—A Nest Building Frog—Horse "Human Nature." 65

Archæology and Ethnology.—Legendary Evolution of the Navajo Indians. 69

PROCEEDINGS OF SCIENTIFIC SOCIETIES. 80

SCIENTIFIC NEWS. 82

RECORD OF NORTH AMERICAN ZOOLOGY. 85

PHILADELPHIA, U. S. A.
BINDER & KELLY,
518 AND 520 MINOR STREET.

tered at the Philadelphia Post Office as second-class matter.

Ch. Marchand's Trade Mark.

CH. MARCHAND'S
PEROXIDE OF HYDROGEN

(MEDICINAL) H_2O_2 (ABSOLUTELY HARMLESS.)

MOST POWERFUL BACTERICIDE AND PUS DESTROYER.
ENDORSED BY THE MEDICAL PROFESSION.
UNIFORM IN STRENGTH, PURITY AND STABILITY.
RETAINS GERMICIDAL POWER ANY LENGTH OF TIME.

USED BY THE HOSPITALS OF THE U. S. ARMY.

Send for free book of 88 pages giving articles by the following contributors: **DR. E. R. SQUIBB,** of Brooklyn, N. Y., **DR. ROBT. T. MORRIS,** of N. Y., **DR. EGBERT H. GRANDIN,** of N. Y., **DR. JOHN AULDE,** of Phila., Pa., **DR. W. F. WAUGH,** of Phila., Pa., **DR. GEO. B. HOPE,** of N. Y., **DR. E. CHAREST,** of St. Cloud, Minn., **DR. G. F. ADAMS,** of Pulaski, N. Y., **DR. H. F. WIGGIN,** of N. Y., **DR. J. A. LARRABEE,** of Louisville, Ky., **DR. R. M. CHASE,** of Bethel, Vt., **DR. ROBT. T. WILSON,** of Baltimore, Md., **DR. J. H. SHERMAN,** of Boston, Mass., **DR. C. M. WOODWARD,** of Tecumseh, Mich., **DR. GEO. H. PIERCE,** of Brooklyn, N. Y., and many others.

NOTE.—Avoid substitutes—in shape of the commercial article bottled—unfit, unsafe and worthless to use as a medicine.

Ch. Marchand's Peroxide of Hydrogen (Medicinal) is sold only in 4-oz., 8-oz., and 16-oz. bottles, bearing a blue label, white letters, red and gold border, with his signature. Never sold in bulk.

GLYCOZONE.

PREVENTS FERMENTATION OF FOOD IN THE STOMACH.
MOST POWERFUL REMEDY FOR HEALING PURPOSES. CURES:

DYSPEPSIA, GASTRITIS, ULCER OF THE STOMACH, HEART-BURN.

Glycozone is sold only in 4-oz., 8-oz., and 16-oz. bottles. Never sold in bulk.

PHYSICIANS WILLING TO PAY EXPRESS CHARGES WILL RECEIVE FREE SAMPLES ON APPLICATION.

BOTH OF THE ABOVE REMEDIES
ARE PREPARED ONLY BY

Charles Marchand

☞Mention this publication.

Chemist and Graduate of the "Ecole Centrale des Arts et Manufactures de Paris (France).

SOLD BY LEADING DRUGGISTS. Laboratory, 28 Prince St., New York.

4

248.

00 per Year. $4.60 per Year (Foreign). 35 cts. per Copy.

APR 10 1893

3479

THE
AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

MANAGING EDITORS:
PROFS. E. D. COPE, Philadelphia, AND J. S. KINGSLEY, Boston.

ASSOCIATE EDITORS:
DR. C. O. WHITMAN, Chicago,
PROF. C. M. WEED, Hanover, N. H.,
DR. C. E. BESSEY, Lincoln, Neb.,
PROF. W. S. BAYLEY, Waterville, Maine,
W. N. LOCKINGTON, Rugby, England.
THOMAS WILSON, Washington,
PROF. E. A. ANDREWS, Baltimore,

Tol. XXVII. APRIL, 1893. No. 316

CONTENTS.

PAGE.

HE GENEALOGY OF MAN. (Illustrated.) *E. D. Cope.* 321

HE PROBABLE PHYSIOGNOMY OF THE CRETACEOUS PLANT POPULATION. *Conway MacMillan.* 336

N EXTREME CASE OF PARASITISM. *Robert Hessler, A. B., M. D.* 346

N THE RELATIONSHIPS AND DISTRIBUTION OF THE NORTH AMERICAN UNIONIDAE, WITH NOTES ON THE WEST COAST SPECIES. *Chas. T. Simpson.* 353

DITORIALS.—Book Publication in America—The Journal of Geology—A Preserve for New Zealand. 359

ECENT BOOKS AND PAMPHLETS. 361

ECENT LITERATURE.—The Woodland of the Southwest, by Chas. F. Lummis—Macmillan's Metaspermæ of the Minnesota Valley—Ridgway on the Anatomy of the Humming-Birds and Swifts—A Rejoinder—Beddard's Animal Coloration. (Illustrated.) 364

ENERAL NOTES.

Geology and Paleontology.—Currents of the North tlantic—Fins of Palæaspis Americana—New eptiles from the Elgin Sandstone—Fossil Reptiles om the Parana—On the Systematic Position of the enus Protogonodon—The Brown Coal and Lignite Texas—Extinct Fauna of Mauritius. 375

Mineralogy and Petrography.—Description of the New Rock Type, Malchite—The Petrography of Hokkaido, Japan—Two Peculiar Rocks from Siberia—An Ottrelite Bearing Conglomerate in Vermont—Lithophysæ in the Rocche-Rosse—The Composition of the Dune Sands of the Netherlands—Quartz-Gabbro in Maryland—Minerals from the Diamond Fields of Brazil—Mineralogical Notes—Optical Anomalies—Isomorphism—Etched Figures—Microchemical Reactions—Miscellaneous. 380

Zoology.—The German Zoological Society—Eyes of Polychæts—Arachnida—The Fishes of the Pacific Coast of America North Cerros Islands—On the Mechanical Genesis of the Scales of Fishes—The Systematic Position of the Kiwi—Mammals from the Galapagos Islands. 388

Embryology.—Echinoderm Eggs—Electricity and Cleavage—Membranes of the Sea Urchin Egg—Experiments on Cleavage. 395

Entomology.—Termitophilous Insects—Notes on the Mouth Parts and Thorax of Insects and Chilopods—The Woolly Alder Aphis. (Illustrated)—Further Note on the Tineid Case-worm from the Grand Canyon—The Puparium of Blepharipeza. . 400

Microscopy.—The Solution of the Dust Problem in Microscopy. (Illustrated)—Cooling Paraffine. . 405

PROCEEDINGS OF SCIENTIFIC SOCIETIES. 409

SCIENTIFIC NEWS. 410

PHILADELPHIA, U. S. A.
BINDER & KELLY,
518 AND 520 MINOR STREET.

ntered at the Philadelphia Post Office as second-class matter.

Ch. Marchand's **Trade Mark.**

GLYCOZONE.

PREVENTS FERMENTATION OF FOOD IN THE STOMACH.
MOST POWERFUL REMEDY FOR HEALING PURPOSES. CURES:
DYSPEPSIA, GASTRITIS, ULCER OF THE STOMACH, HEART-BURN.

Glycozone is sold only in 4-oz., 8-oz., and 16-oz. bottles. Never sold in bulk.

CH. MARCHAND'S
PEROXIDE OF HYDROGEN

(MEDICINAL) H_2O_2 (ABSOLUTELY HARMLESS.)

MOST POWERFUL BACTERICIDE AND PUS DESTROYER.
ENDORSED BY THE MEDICAL PROFESSION.
UNIFORM IN STRENGTH, PURITY AND STABILITY.
RETAINS GERMICIDAL POWER ANY LENGTH OF TIME.

USED BY THE HOSPITALS OF THE U. S. ARMY.

Send for free book of 88 pages giving articles by the following contributors:

DR. PAUL GIBIER, of N. Y., **DR. S. POTTS EAGLETON**, of Phila., Pa., **DR. CHAS. P. NOBLE**, of Phila., Pa., **DR. C. A. PHILLIPS**, of Boston, Mass., **DR. J. H. DeWOLF**, of Balti., Md., **DR. JOHN V. SHOEMAKER**, of Phila., Pa., **DR. W. S. MULLINS**, of Henderson, Ky., **DR. CHAS. W. AITKIN**, of Flemingsburg, Ky., **DR. H. F. BROWNLEE**, of Danbury, Conn., **DR. J. LEWIS SMITH**, of N. Y., **DR. J. MOUNT BLEYER**, of N. Y., **DR. A. S. TUCKLER**, **DR. N. H. HAIGHT**, of Oakland, Cal., **DR. W. B. DEWEES**, of Salina, Kas., **DR. C. E. PERKINS**, of Sandusky, O., and many others.

NOTE.—Avoid substitutes—in shape of the commercial article bottled—unfit, unsafe and worthless to use as a medicine.

Ch. Marchand's Peroxide of Hydrogen (Medicinal) is sold only in 4-oz., 8-oz., and 16-oz. bottles, bearing a blue label, white letters, red and gold border, with his signature. Never sold in bulk.

PHYSICIANS WILLING TO PAY EXPRESS CHARGES WILL RECEIVE FREE SAMPLES ON APPLICATION.

BOTH OF THE ABOVE REMEDIES
ARE PREPARED ONLY BY

Charles Marchand

☞Mention this publication.

Chemist and Graduate of the "Ecole Centrale des Arts et Manufactures de Paris (France).

SOLD BY LEADING DRUGGISTS. **Laboratory, 28 Prince St., New York.**

3

)0 per Year. $4.60 per Year (Foreign). 35 cts. per Copy.

6526

THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

MANAGING EDITORS:
PROFS. E. D. COPE, Philadelphia, AND J. S. KINGSLEY, Boston.

ASSOCIATE EDITORS:
C. O. WHITMAN, Chicago,
DR. C. E. BESSEY, Lincoln, Neb.,
THOMAS WILSON, Washington,
F. C. M. WEED, Hanover, N. H.,
PROF. W. S. BAYLEY, Waterville, Maine,
PROF. E. A. ANDREWS, Baltimore,
W. N. LOCKINGTON, Rugby, England.

l. XXVII. MARCH, 1893. No. 315

CONTENTS.

PAGE.
: QUANTITY OF HUMAN LIFE. *J. Lawton Williams.* 193
: TITANOTHERIUM BEDS. (Illustrated.) *J. B. Hatcher.* 204
ORGANISM PRODUCED SEXUALLY WITHOUT CHARACTERISTICS OF THE MOTHER. (Illustrated.) . . . . *Th. Boveri.* 222
THE CLASSIFICATION OF THE LONGIPENNES. *R. W. Shufeldt.* 233
TORIALS.—The Geological Survey of Illinois—Reform in Orthography—Mortality of the English Sparrow—The American Entomological Society. 238
ENT BOOKS AND PAMPHLETS. 240
ENT LITERATURE.—Memoirs of the National Academy of Sciences, Vol. V.—Brooks and Bruce on the Embryology of the Macrura—Campbell's Biology—Correlation Papers of the U. S. Geological Survey; Neocene—Cary on the Evolution of Foot Structure—Earle on the Species of Coryphodontidæ. 243
IERAL NOTES.
'eography and Travels.—Africa—America—ı—Australasia—Europe—The Polar Regions—eral Notes. 253
'eology and Paleontology.—Geology of Eastern ıia—Geological Features of Arabia Petræa and stine—The Vertebrate Fauna of the Ordovician Colorado—The Loess in Southern Russia—rces of the Texas Drift—Archean—Paleozoic—ozoic—Cenozoic. 267
Mineralogy and Petrography.—The Rocks of the Thalhorn—The New Jersey Eleolite-Syenite—Mica Peridotite from Kentucky—Rhyolites in Maryland and Penn—The Nepheline and Leucite Rocks of Brazil — Petrographical News — Crystallographic Study of Diopsides—Herderite from Hebron, Maine—Mineralogical Notes—New Minerals—Synthesis of the Members of the Sodalite Group—Methods and Instruments—An Appendix to the "Gems of North America." 272
Botany.—An International Botanical Congress—Botanical Notes. 279
Zoology.—Allen's Faunal Areas of North America—The Madagascar Fauna—The Nephridia of Amphioxus—The Position of the Marsipobranchs—Degeneration of the Human Clitoris—Zoological News—Reptiles—Batrachia. 282
Embryology.—The Star-fish Larva—Germ-layers of Amphioxus—Epigenesis—Form and Chemical Composition. 288
Entomology.—The Pear-Three Psylla. (Illustrated.)—Insects of Southern Alaska—Notes on Ohio and Other Phalangiidæ — Gall-Producing Insects—Recent Publications. 293
Psychology.—The Sense of Taste in a Sea-Anemone—M. Vaillant on the Feeding of Snakes . 298
Archeology and Ethnology.—International Congress of Americanists. 300
PROCEEDINGS OF SCIENTIFIC SOCIETIES. 306
SCIENTIFIC NEWS. 314

PHILADELPHIA, U. S. A.
BINDER & KELLY,
518 AND 520 MINOR STREET.

:red at the Philadelphia Post Office as second-class matter

3 2044 093 308 575

Date Due

~~JUL 31 1991~~